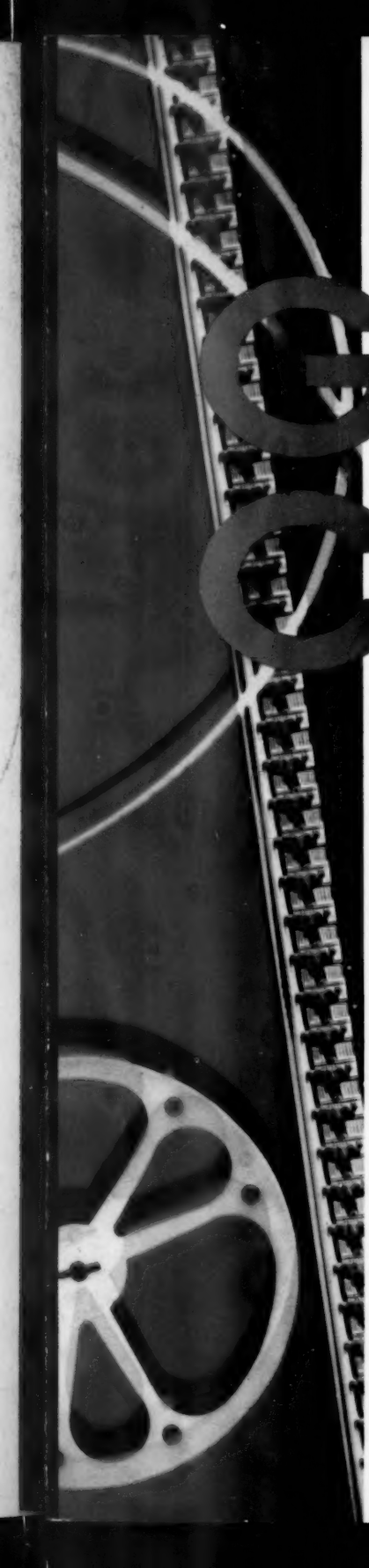

Graphic Communication

AND THE CRISIS IN EDUCATION

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FOREWORD

THE PRESENT "crisis in education," in which our birth rate and the demands for greater formal education are outdistancing our capacity to supply a trained teaching force or adequate facilities, has given rise to increased public discussion of the part graphic communication can play in education and training. It is apparent that there is no simple solution to the current predicament. Many attacks from different ideological viewpoints are being made upon the problem, not the least important of which is being made by those who feel that a wider use of graphic materials might help solve the crisis by improving teaching and learning.

This book is an attempt to summarize the ideas which erupted when a group of men selected to represent a wide background of scientific and practical achievement were brought together to consider in broad perspective the problems of graphic communication in education. It is actually an unusual blend of heterogeneous material, a natural result of unstructured meetings where no constraint was placed on the participants other than limiting their discussion to the problem.

The result is a document consisting of two parts. The first part, "The Barriers to Optimum Use and Suggestions for Overcoming Them," is a somewhat free-floating informal discussion of a number of problems facing schools in the use of graphic communication today. Since this is a report of what was actually contributed during the meetings, rather than an attempt to make a definitive statement, the careful reader will discover many omissions of pertinent ideas; he should also discover thought-provoking discussion of relevant topics.

On the other hand, the second part, "Scientific Principles for Maximum Learning from Motion Pictures," is a more organized statement of a point of view and represents in particular the psychological orientation of the senior author, Professor Neal E. Miller. In my opinion, this section of the book is a significant contribution to the field of audio-visual communication and represents the first

formal attempt to integrate the findings from audio-visual communication research into the organization of a theory of learning. In so doing, this section raises many fruitful problems for future research.

The ideas in this document were expressed during two conferences held at the Yale University Institute of Human Relations on September 18-19, 1953, and April 23-24, 1954. The idea for conferences of this kind originated with Mr. James W. Young of the J. Walter Thompson Company, and Mr. W. B. Potter and Mr. John Flory of the Eastman Kodak Company. The latter company paid the expenses for the conferences, but made it perfectly clear that they did not want to influence the conferences in any way and were interested solely in the long-range goal of advancing the general effectiveness of all forms of graphic communication in education. Responsibility for planning and conducting the conferences was turned over to Professors Neal E. Miller and John Dollard of Yale University.

WILLIAM H. ALLEN, EDITOR
Audio-Visual Communication Review

Santa Monica, California
October 21, 1957

Contents

part I BARRIERS TO OPTIMUM USE AND SUGGESTIONS FOR OVERCOMING THEM

CHAPTER 1. Introduction 3

CHAPTER 2. Cultural Lag 5

CHAPTER 3. Building Schools for the Past or the Future? 7

Equipment Not Adapted to Educational Needs 8

Liaison Between Manufacturers of Equipment and Educators 9

CHAPTER 4. Better Educational Films 11

Obsolescence 11

Adapting Cinema and TV Productions for Educational Use 12

Need for New Kinds of Films 12

Pictorial Tests 13

Importance of Producing Films That Teach Effectively 14

Job Analysis: Specification of Objectives 14

Close Collaboration Between Teacher and Producer 14

Production of Materials by Educational Institutions 15

Proper Administrative Arrangements for an Audio-Visual Center 16

Rewards for Producing Films 16

Combating Noneducational Traditions 17

More Economical Production Techniques 18

A Manual and Film Summarizing Production Techniques 19

Need for Analysis of Economic Factors in Production and Distribution 20

CHAPTER 5. Difficulties in Procuring Existing Material 21

Finding Existing Material 21

Improving Catalogs 22

Exposing Teachers to Good Materials 22

Publicizing the Best Things 23

Need for Packaged Source Units 24

A Consolidation of Agencies into a Comprehensive Audio-Visual Center 24

CHAPTER 6. Integration of Graphic Material with the Textbook 26
Materials Should Be Tested 26
Achieving Integration 27
Some Hopeful Steps in the Right Direction 27
A Manual on How To Illustrate a Textbook 28
A Conference of Top-Level Representatives 29

CHAPTER 7. Acute Curriculum Problems 30
Improper Use of Film 30
Overcrowding 31
Pressure To Pass Examinations 31
Clarifying Objectives 32
Cooperation Between Educational Thinkers and Graphics Specialists 33
A New Look 33

CHAPTER 8. The Teacher 35
Technological Advances Increase Professional Rewards 36
Teachers Selected for Verbal Ability 36
Snobbery of the Book and Lecture 37
It Isn't Being Done 38
Combating the Entertainment Set 38
Information on How To Use Visual Materials 39
Appealing to Professional Conscience 40
Improving Teacher Education 40
Teacher Education Institutions 41
A Survey Plus a Consultant Service 42
Summer Workshops and Refresher Courses 43
Improving Personnel in Graphic Education 43
Broadening the Scope and Changing the Title 44
Summer Workshops—A PhD 44
New Fellowships 45
Broader Perspective via Audio-Visual Journals 46

CHAPTER 9. Practical Demonstrations of Effectiveness 47
The Prototype Classroom 47
A Model Program in Psychology 48
Films Demonstrating Superior Teaching Techniques 49

CHAPTER 10. Securing Support from a Wider Audience 51
What Publications Are Most Important 51
Reaching the Administrators and the General Public 52
Educational Television—Demonstrations of Effective Teaching 53

Need for Organized Exchange of Information 54
Value of Factual Surveys of Sources of Resistance 55
Correcting Lack of Industry Support of Research 57

part II SCIENTIFIC PRINCIPLES FOR MAXIMUM LEARNING FROM MOTION PICTURES

CHAPTER 11. Need for Research Guided by Theoretical Analysis 61
Plan of the Following Discussion 63

CHAPTER 12. Drive: The Student Must Want Something 64
Less Knowledge about Influencing Motivation than Communicating Information 64
Importance of Knowledge about Influencing Attitudes and Motivation 65
Some Hypotheses about Changing Motivations and Attitudes 66
Expanding Range of Motives Studied—Intellectual Curiosity Versus Fear of Being Different 69
Need for Better Measures of Motivation 70
Effects on General Emotion or Mood 72
Motivating Students To Learn from Films 73
Some Motivation Can Be Built into the Film 73
Role of Examinations in Arousing Motivation 74
Role of Teacher in Arousing Motivation 74
Drives Should Be Relevant 74

CHAPTER 13. Cue: The Student Must Notice Something 76
Motion Picture's Supremacy in Visual Cues 76
Effects of Various Modalities 77
Summation Versus Interference of Cues 78
Research on the Sound Track 78
Realism—How Pictures Are Perceived 79
Realism—Learning from Pictures 81
Physical Conditions of Viewing—Fidelity of Picture 82
Focusing Attention on Relevant Cues 82
Abstraction 83
Realism Versus the Relevant Cue 84
Role of Job Analysis in the Selection of Cues 85
Research on Teaching Discrimination—How To See Better 85
Research on Representing Motion—Animation 87
Some Additional Research Problems 87

CHAPTER 14. Response: The Student Must Do Something 89
Need for Research on Responses to Pictures 89
Basic Response Units Must Be Present 90
Learning from Demonstrational Films as Delayed Imitation 92
Participation and Mental Practice 93
Analytical Studies 93
Need for New Equipment and New Types of Film 94
Type and Timing of Response 95
Motivation Favors Relevant Responses 95
Rate of Development 96
Summaries and Reviews 97

CHAPTER 15. Reward: The Student Must Get Something He Wants 98
Delay Reduces Effectiveness 98
Films Depend on Learned Rewards Reinforced in Real Life 98
Knowledge of Results 99
Reward for Matching a Model—Copying 99
Problems for Research and Development 101

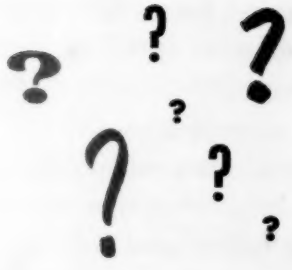
CHAPTER 16. Problems Involving a Number of Factors 104
Specificity Versus Generality 104
Superiority of Logical over Rote Learning 105
Meaningfulness and Organization of Material 106
Forgetting and Review 107
Value of Demonstrating Errors 108
Dramatic Versus Expository Presentation 108
Type of Audience 108
Study Habits for Films 108
Additional Comments on Research 109
Applicability to Children of Research on Adults 109
The Free Versus the Captive Audience 109
Interchange of Ideas 110
Research on the Principles of Film Editing 111
Evaluating Films 111
Measures of Savings Versus Recall 111
Testing Validity and Improving Efficiency of Evaluation 111
Money for Creative Men and Their Students Versus Project Proposals 112

Bibliography 114

Participants 118

part I

BARRIERS TO OPTIMUM USE AND SUGGESTIONS FOR OVERCOMING THEM



BARRIERS TO OPTIMUM USE AND SUGGESTIONS FOR OVERCOMING THEM

1

Introduction

RECENT applications of science and technology have beneficently transformed almost every facet of our lives. We use the telephone to talk to loved ones who are far away. High-fidelity recording gives us a choice of fine music beyond the means of the most powerful kings of former years. The car and plane revolutionize transportation. Refrigeration improves our winter diet, while automatic heating keeps our homes comfortable. The sewing machine, vacuum cleaner, washing machine, disposal, and dishwasher reduce drudgery in the home. Power machinery replaces the muscle of horse and man on farm and assembly line. New methods, materials, and products permeate industry; the typewriter, dictaphone, and computing machine streamline the office. Since 1900, the tragedy of the death of children during the preschool years has been reduced sixfold.

Compared with these enormous strides, our educational system has been slow in using the technical advances of science to transform its practices. We believe that education can meet the enormously increased demands placed upon it only by making a concerted effort to catch up with the scientific and technical advances which have revolutionized other areas of our lives.

The main purpose of this report is to show how some of the acute problems of education can be solved by the much wider use of the new methods of graphic communication. We urge, however, that imagination also be used to create other new solutions to teaching problems.

A promising beginning has already been made by alert teachers. Phonograph records are helping to teach foreign languages, and tape recorders enable students of public speaking to hear how they sound to others. Eye-movement cameras are being used to diagnose bad reading habits and projection devices to cure them. We believe that a great variety of other useful methods can be invented and should be widely employed.

An enormous amount of old-fashioned drill is absolutely necessary to master some of the basic units of elementary education —e.g., addition, subtraction, multiplication, division, spelling, and reading. But this drill does not need to be administered by old-fashioned methods. It has long been known that immediate knowledge of results—promptly rewarding correct responses and promptly correcting errors—is extremely important. Thus, each student would learn best if he had his own private tutor, a luxury only the wealthy can afford. As a challenging article by Skinner (1954) points out, however, it is easily possible to construct a recitation device which gives each student the benefit of individual arithmetic drill with immediate reward and correction. Children love to operate this apparatus. We believe it can speed learning and save time for studying different subjects by other methods.

With ingenuity and imagination, it should be possible to construct other types of tutoring devices to improve drill in many subjects. By transferring the burden of drill to the machine, the teacher can be freed for more important roles—planning learning sequences, solving special problems, and giving personal guidance to each pupil. The prestige of any profession increases as the effectiveness of its techniques improves.

Imaginative people, who know the problems of education, the principles of learning, and the potentialities of scientific technology, should review each of the fundamental elements of the curriculum to see whether or not some radically novel and superior way of teaching it can be invented. Although this report is limited to graphic communication, the attempt to help education to catch up with the advances in other areas of life should cover the whole range of modern technology and science.

BARRIERS TO OPTIMUM USE AND SUGGESTIONS FOR OVERCOMING THEM

2

Cultural Lag

IDENTIFYING specific sources of resistance to the optimum use of the graphic media in education is the first step toward devising ways of overcoming each resistance. If we can make an accurate diagnosis, perhaps we can prescribe the cure. At present, our main source of knowledge about the resistances is expert opinion, supplemented by some surveys. We need more factual studies pinpointing the factors blocking the best use of graphic communication in education. Some of the most important sources of difficulty and the practical suggestions for remedying them are discussed in the following chapters. First we shall briefly discuss the general factor of cultural lag.

For hundreds of thousands of years, the human voice was the best instrument of instruction. Some 4000 years ago, the manuscript froze the voice for later generations. But manuscripts remained rare and costly, and their precious knowledge could be imparted only to a favored few. Five hundred years ago, the invention of the printing press enormously speeded up the spread of ideas. For these last five centuries, the teacher's voice and the book have dominated learning.

Finally, beginning haltingly 100 years ago, there has been an accelerated rush of new inventions—the photograph, the lantern slide, the filmstrip, the motion picture, and television. The concreteness of the vast visual world is at last available to the student—but only potentially. The development and use of the new techniques requires the change of old habits, habits which have been crystallized and sanctified for centuries.

It is always hard to get people to change their methods of work. For example, although the introduction of hybrid corn required no new capital investment, no radical change in habit patterns of farming practices, it took almost 20 years before hybrid corn was fully accepted in Iowa. Many farmers did not change over to the new seed even after their neighbors had already done so; first they planted their own experimental plots of hybrid corn. But later, hybrid oats were fully accepted within the short span of three years.

Fitting the new graphic techniques into education is a complicated process. It involves learning new habits, forming new attitudes, changing the system of prestige and reward, making new administrative arrangements, and altering the established pattern of the curriculum. Research must tell us more about how, when, and where to accent the visual. Once a new technique is invented, engineering developments must be pioneered and a market developed. A host of individual and social factors contribute to the lag in social acceptance.

But cultural lags are not inevitable. The same techniques which have been relatively neglected in the educational field—the motion picture and television—have profoundly affected the field of entertainment. Magazines, such as *Life*, have successfully exploited pictorial techniques. What are the specific factors which have contributed to the cultural lag in education, and how may progress be accelerated?

Building Schools for the Past or the Future?

THE FACT that many school buildings are not designed for the convenient, effective use of the newer visual techniques hinders effective teaching. Furthermore, present equipment is not completely adapted to the special requirements of teaching. Many of the inadequacies are not obvious because most of us are not keenly enough aware of what could be accomplished with suitable equipment in a properly designed school.

New schools must be built to accommodate increased enrolment. Will these schools be designed and equipped to meet the needs of 25 years ago, the needs of the present, or the needs of the future 25 or more years during which they will be used?

Unfortunately, the design of schools and classrooms is not usually controlled by the people who are going to use them, but rather by the building-and-grounds people, the comptrollers, boards of trustees, or schoolboards. In general, such groups are advised by paid professional educational consultants on school building and by architects, who often are not closely enough in contact with the day-by-day problems of teaching and are not aware of the modern potentialities of graphic communication. Steps should be taken to bring about a closer liaison between the teachers, the architects, and the administrators who control decisions about school buildings. Such liaison groups should inform themselves of the most recent developments and the probable trends of the future. They could look for new ideas and test them under actual conditions of everyday use in experimental prototype classrooms.

Equipment Not Adapted to Educational Needs

One of the important sources of resistance to the use of pictorial techniques, especially the motion picture, is the trouble involved. This is not unique to pictorial techniques. Nobody can argue against the importance of laboratory and field trips in science, but a great deal of general science is taught without a laboratory and a very high proportion of biology is taught without any field trips at all. Anything that involves administration outside of the classroom is trouble. If you are going to do anything more than reach for a book, you are going to run into difficulty—decisions, routines, and administrative action beyond the scope of the individual teacher's authority. But in conjunction with properly designed schools, properly designed equipment cheap enough so that it could be available in each classroom, would go a long way toward solving these difficulties.

One of the important reasons why teachers do not make more use of films is that they run into so many frustrations in trying to use the equipment. It is hard to darken the room. Since there are not enough projectors, special arrangements have to be made to get one. Although projectors have been improved, they still tend to be costly, noisy, heavy, and complicated. In many cases, the newer and better types of equipment have not been purchased. In other cases, the types of equipment which the teacher needs for educational use have not yet been produced.

Often what the teacher really needs is a number of short 30-second to five-minute bits of demonstration material which can be fitted into the context of a lesson. For example, in 30 seconds the motion picture can convey a better idea of the locomotion of the amoeba than can a much longer period of talking, drawing diagrams on the blackboard, or a laborious attempt to find and demonstrate to individual students an amoeba under a microscope.

The teacher not only needs to have these shorter specific films available, but he also needs to be able to utilize them effectively. In the average antiquated classroom, no one is going to pull down the shades, turn out the lights, set up a projector, and thread it, in

order to show a two-minute film or filmstrip, then reverse this whole process, talk some more, and then go through the whole thing again. We need to design and produce radically new kinds of equipment that will make use of the great potentialities of the motion picture and the filmstrip, but with the same facility and flexibility as the blackboard. In addition to making the graphic materials more efficient in teaching, we also need to make their use easier and more rewarding to the teacher.

Specifically, some of the greatest needs are:

1. Better daylight screens
2. A projector so designed that it can be operated without forcing the instructor either to leave the front of the room or to arrange for a separate projectionist
3. A magazine-loading projector so that one can simply press a loaded film magazine into a slot and show a few minutes or seconds of film without a complicated threading and operating procedure
4. The preparation of short clips or loops of film to allow for repetition if desired.

A considerable amount of experimental work has already been done on devices to meet each of these needs. The further development of such devices and their adoption as standard equipment for the average classroom will enormously facilitate the use of graphic methods to improve teaching.

Liaison Between Manufacturers of Equipment and Educators

Means should be found to keep equipment manufacturers in touch with the problems of the classroom so that they can get ideas about the real needs and possibilities. One way of doing this would be to set up a liaison working group under the joint sponsorship of the Society of Motion Picture and Television Engineers, the National Education Association, and the American Council on Education. This effort might be related to the work of the Committee on Standards, which might expand its function from problems

of physical engineering to embrace those of human engineering in the classroom.

The task of such a liaison working group will be difficult and will require imagination. It will not be easy to get a clear-cut statement of all the educational needs from the teachers, because in many cases demands do not occur until people realize the possibility of doing something new. One way of meeting this situation would be to canvass imaginative teachers for ideas, have some group screen these ideas, obtain financial support for developing the best ones, and then test out prototype models in an experimental classroom. Such classrooms would give a chance to test the teaching effectiveness of new ideas, to refine them, and to determine whether the average teacher would want them after having tried them out for a long enough period under actual conditions of everyday teaching.

One outstanding case in which the needs of the field have generated a special piece of equipment occurred when the football coaches began to express some kind of organized opinion. The result was a silent motion picture projector with which one can scan frames backward and forward to analyze the details of action. In certain subjects, classroom teachers might find this projector useful if they were only made aware of its potentialities. It seems highly likely that many other special types of equipment could be designed, profitably sold, and effectively used in education, if some farsighted way could be found to discover the special needs and to communicate these needs to the inventors and engineers.

BARRIERS TO OPTIMUM USE AND SUGGESTIONS FOR OVERCOMING THEM

4

Better Educational Films

AFTER STUDYING approximately 4000 elementary and secondary school teachers and 500 principals in the state of Washington, Hite (1951) concluded that lack of materials was one of the important factors retarding the educational use of films.

We believe that, as far as the conventional types of material are concerned, competition and a wide market are well on their way toward solving this problem at the elementary-school level. At this level, the difficulty is shifting from the nonexistence of films to the fact that they still cost too much and that budgets for buying them are still too low.

As one progresses through high school and college, however, one runs into increasing difficulty in finding suitable films. Furthermore, availability varies with the subject material. Social studies and biology are moderately well supplied, but English literature, mathematics, and other higher-level subjects are in great need of more good films.

Often films about a given subject may exist, but they may not be what is needed in a particular curriculum. There are not enough good films to achieve specific stated objectives.

Obsolescence

In military and industrial training, and to a somewhat lesser extent in school subjects, there is the problem of obsolescence. In some instances, films are obsolete even before their production is

completed. If films were made in shorter specific pieces, obsolete parts could be replaced instead of scrapping entire films. Shorter units would increase the difficulty of cataloging, however.

Obsolete films should be removed from libraries and catalogs.

Adapting Cinema and TV Productions for Educational Use

A number of excellent theatrical films have been adapted to school use by committees of teachers working in cooperation with the Teaching Film Custodians, a nonprofit organization with royalty-free access to the products of the major Hollywood studios. Some of the most useful films for teaching English and history are excerpts from motion pictures based on books which constitute a part of the curriculum. Without the enormous resources of Hollywood, it would be difficult to duplicate the scenes in these films.

The rapid growth of television opens up a new source from which an organization analogous to the Teaching Film Custodians could glean materials of great educational value. Imaginative educators could probably find new ways of extending the usefulness of suitable excerpts from commercial productions to additional subjectmatter areas. In many other instances, however, the problem must be solved by materials that are especially created to meet specific educational needs.

Need for New Kinds of Films

The Hollywood and the pedagogic traditions result in films which present a story lesson. While the story technique is well adapted to teaching some subjects, such as English literature, it is less well adapted to teaching others, such as geometry. As a result of the emphasis on the story technique, the more modest goal of bringing otherwise unavailable illustrative material into the classroom is often neglected. There is an important role for more films which are the equivalent of a field trip or demonstration—films

which bring the world into the classroom. Such films are essentially recordings and do not require elaborate staging.

Many educational films are too long. In a crowded curriculum, only a short time may be available for the presentation of given kinds of information. A good instructor wants to set the stage, motivate the student, present the pictorial material on the screen, and then integrate this material with the rest of the lesson. Frequently, this leaves room for only five or ten minutes of film. Often the material can be presented adequately in a very short time. As we have pointed out, 30 seconds is adequate for giving a demonstration of the locomotion of the amoeba.

Pictorial Tests

One of the challenging new areas for the use of pictures, slides, and films is to test for significant types of learning or perception which are difficult to measure with mere words. Such tests can present diagrams or realistic, lifelike stimuli to which the student is asked to respond. During World War II, the Air Force (Flanagan, 1948) developed a number of pictorial test booklets and conclusively demonstrated that such tests were reliable and valid for selecting pilots. Recently, slides have been found useful in biology courses for testing the recognition of various animals, plants, and structures. The teacher presents a slide of a leaf and asks the student to write down what type it is, e.g., palmate.

Suitable pictorial tests would probably be highly useful in a wide variety of situations such as art, architecture, map reading, shop safety, etiquette, and leadership. It is often important for the student to learn to perceive complex patterns of stimuli and respond appropriately to them. In such cases, the greater realism of pictorial techniques ought to help make classroom tests more relevant to life.

Pictorial and film tests should not be made as mere substitutes for paper and pencil tests; they should be developed as something completely new, making use of the unique potentialities of the pictorial medium.

Importance of Producing Films That Teach Effectively

The production of the right kind of film is especially important because some of the most significant factors which affect the teaching value of a filmstrip or motion picture can be controlled only while it is being produced. The great practical importance of these factors is shown in a study by Jaspen (1950). He found that a version of a training film, which was typical of many educational films, taught only 46 percent of naval students to assemble correctly the breech block of the 40mm antiaircraft gun. But a film which tried to apply better principles of learning taught 98 percent of the students to perform the task correctly on the first attempt. The better version was more than twice as effective! This result shows the value of research on the factors influencing the teaching value of films. We shall have more to say about specific factors to be considered in planning and producing a film in a later section on the scientific principles for getting the best possible learning from motion pictures.

Job Analysis: Specification of Objectives

In order to produce a good film, one must first make a correct analysis of the teaching task. Many films fail at this step. First one must define one's objectives clearly—in other words, know in detail what constitutes the expert performance or the desired standard of knowledge or behavior. Then one must find out what units of information or skill the student already has, and formulate a feasible plan for progressing from the present status of the student to the desired objective. This plan should be written down in a detailed production outline.

Close Collaboration Between Teacher and Producer

In order to get the right kind of films produced, we must have close cooperation between the teacher and the photographer-

producer. The teacher knows what points to make, how the film will be used, how much time is available, etc. The photographer, in turn, knows the techniques for illustrating the material pictorially and producing the film. One of the reasons why good films are not made is that the producer does not know the need for and the proper objective of the film, while the teacher does not know how to make a film to achieve that objective. It would be profitable for some organization such as the University Film Producers Association to sponsor more exchange of ideas between film producers and educational thinkers, and for the different professional associations of teachers to appoint working groups to canvass the needs for graphic materials in each of their specialties.

Production of Materials by Educational Institutions

One way of securing more materials that are better adapted to specific teaching needs is to have such materials produced within the educational system as well as outside of it. Most textbooks are written by teachers who have tried out the material on their own classes. Successful teachers should also have the opportunity to produce graphic materials. Many teachers are inhibited by the popular misconception that an ordinary person can't make a motion picture—that this is an enormous, mysterious operation. Such is not the case. Film-producing units are operating in some schools and more should be established within the educational system, especially at the leading universities and teachers colleges, to help teachers make the kind of films they need.

Promising starts have already been made in a number of places. But all too commonly, economic pressures keep school production units busy making films for alumni associations, highway departments, political organizations, and even industries, instead of for teachers. With so many topics deserving film presentation, it is hoped that members of the University Film Producers Association will help fill the gap, just as university presses turn out textbooks and scholarly works. The trend toward closer collaboration between producers, both educational and commercial, and teachers, should also be encouraged.

Proper Administrative Arrangements for an Audio-Visual Center

Production units in schools must be given good status or they are likely to attract only second- or third-rate people who are neither good photographers nor well educated. Such centers should be supported from the central administration funds and have a direct line of communication to the administration. They should have their own separate budgets. They should operate as the library does and not have to charge the departments for each service. They should have a revolving fund for production. Each year the administration should contribute a certain amount which can be ploughed into the production of new classroom materials. Then from the sale of prints to other institutions, they should get money which can be put back into this fund, gradually building it up until they have a sizable revolving fund with which to operate.

Such units should not only produce and distribute materials but also test and evaluate them.

Several university motion picture production units might be selected by some great foundation and helped to remodel their plans and functions. Those that are most successful could be given high public visibility as models of what can be achieved.

Rewards for Producing Films

If one wants to have better people making better films, one has to find some way of rewarding them. An author may make money by writing a book, and even if he doesn't make money directly, the book gives him prestige which may result in a promotion. A book can be casually displayed in an office or a home, but a film cannot. When men are to be promoted, the administration looks over lists of books published but not of films produced. Books may be used as PhD dissertations in education, but films are not usually acceptable.

In films, the actor tends to be the star, not the writer or the

director. Because the production of a motion picture involves many people, credits are difficult to assign. Thus MacLeish got little prestige for writing and speaking the narration of a film on Grandma Moses. There is much less prestige in being the author of a film than in being the author of a book.

A definite attempt should be made to increase the prestige coming from the authorship of a valuable film. Films should be included in personal lists of publications, and faculty committees and administrators should be educated to consider them when making promotions.

Combating Noneducational Traditions

The things that reward the film-maker may be different from those that reward the teacher using the film. At present, many producers of classroom films are strongly influenced by the standards and traditions of dramatic artistry which have been developed in the production of theatrical films. While these artistic qualities add immensely to the satisfaction of going to the movies, they are often irrelevant in educational films. For example, Lumsdaine (1955) has reported an experiment in which the amount learned from a finished product in color which cost $28,000 was apparently no greater than the amount learned by comparable groups from a black and white "pencil test running reel" of the same film which cost only about $1500 to produce. Expensive production techniques are not always useless, but a better selectivity among them should allow a greater number of effective educational pictures to be produced more cheaply.

With the advent of sound films in the theatre, tradition against the splicing of titles into the picture developed. The producers of educational films need not be bound by this tradition. They should feel free to print as many legends, questions, or explanations on the film as are needed.

Most instructional films have become standardized in units of 400-foot lengths—another generalization from the entertainment

industry, since a standard 1000-foot 35mm reel becomes 400 feet when reduced to 16mm. Storage cabinets in film libraries are generally built to take cans in units of 400 feet. This traditional standardization has resulted in some resistance to the production of shorter sequences and loop films which are often needed for specific educational objectives.

Because Hollywood has been so spectacularly successful, instructional films have been dominated too much by generalizations from the entertainment film. We need to create many more bold new methods appropriate to the different requirements of instruction.

More Economical Production Techniques

Cutting down production costs would help to make available films that meet very specific needs. Both shorter films and simplified production techniques reduce costs.

In all three services of the Armed Forces, there is a strong trend toward the shorter, simpler, more specific film. In the Air Force, for example, previous policy, stressing headquarters-controlled training films designed to have Air-Force-wide application, has been superseded by recognition of the need for "film aids" in the form of short, specific films designed to pinpoint instructional requirements of a particular school or course. To implement this alternative concept, the Air Force has set up mobile camera teams which can move from base to base on short notice to produce materials designed specifically to meet the needs of the local teaching situation.

One of the reasons films are not more widely used is because they are not available to cover the great many specific items that are needed. One of the ways to make films available more rapidly and more cheaply for specific needs is to use the television techniques which follow through a given action.

More attention might be given to the method of making films which are in effect a record, skillfully done, of a live situation—

even records of a very good lecture or bit of instruction. This has been done by television, which sets up a number of cameras and follows straight through a whole discussion or action. Films can be produced much faster and somewhat more cheaply this way. But we also need techniques to keep up the interest value of a lecture for longer periods of time than we ordinarily can. One of these might be photographing not merely a man lecturing, but the whole context of the lecture. Furthermore, we should remember that the value of the picture depends on the quality of the event; if one has an exceptionally good event, it is worthwhile to use photography to record this wonderful natural occasion, but if the event is boring, the picture will be boring.

A Manual and Film Summarizing Production Techniques

A manual is needed to summarize and bring together from a number of sources the best ideas on production techniques for educational pictures. This manual could summarize the research results and learning principles relevant to the production of films which teach more effectively. It could emphasize some of the newer, faster, cheaper techniques for making pictures, and include research and cost-accounting evidence for the value of these techniques. It could describe the various steps of production—from job analysis, film specification and planning outline, through short test shots of various crucial elements, to editing, pretesting and revising. It could list the equipment that is necessary to achieve various results and describe the ingenious time-and-money-saving methods which have been developed as the results of extensive practical experience. One of the functions of such a manual would be to dispel the idea that local production has to be prohibitively expensive.

A series of illustrations and films should be planned to go with this manual. For example, the effects which can be achieved by different kinds of lighting could be illustrated by still pictures. A film could be made to illustrate the different ways in which a motion

picture camera can look at the world. This could be done cheaply by cutting from existing shots. Similarly, a film could be made illustrating what can be accomplished by various techniques of editing, animation, etc. Such a manual, accompanied by illustrations and films, could gather together and summarize a wealth of practical experience and recent innovations. It would be an immense help to the teacher who wants to make an instructional film.

Need for Analysis of Economic Factors in Production and Distribution

Better films may not become rapidly available unless we straighten out the economics of production and distribution. The use of newer, faster, cheaper production techniques is one part of the problem. But we need a factual analysis of all the economic factors in film production and distribution. We should find out what the costs are, how they are distributed, and what steps need to be taken to make the production of better films profitable. Under present conditions, a one-reel sound print that costs a distributor $12 often must be sold for as much as $75. This is an enormous markup; ways should be found to reduce it. Furthermore, films often are produced on a shoestring budget. The producer does not have the right kind of equipment or the help he needs because he cannot afford it. A study should be made of the economics of educational film production and distribution. If we knew what it would cost to put into effect a program using superior graphic techniques, we could give our legislators and taxpayers something to aim at.

BARRIERS TO OPTIMUM USE AND SUGGESTIONS FOR OVERCOMING THEM

5

Difficulties in Procuring Existing Material

THE TEACHER often fails to use graphic materials because it is too difficult to discover and procure them. A teacher can easily lecture about the year 1812, but to show a motion picture on that topic involves the following: (1) knowing that there is such a film, (2) requisitioning and paying for the film or scheduling it at the film library, (3) previewing the film, (4) getting and running the equipment to show the film to the class, (5) bringing out the relevancy of the film to what has already been discussed and studied in class and what will be taken up next, (6) returning the film to the library or rental agency. A very popular film may not be available on the day that the instructor wants it; a film intended to introduce a topic may arrive so late that it can be used only as a review.

Finding Existing Material

Even when good films exist, teachers often don't know about them. There are many frustrations involved in discovering the right materials and getting hold of them at the right time. In revising his audio-visual book, Edgar Dale found that from 200 to 300 films might possibly be appropriate to recommend. It was a tremendous task to cull these out and find the ones that actually were appropriate. This culling was necessary because the minute the teacher uses one of the films and finds it not appropriate, he says, "I won't waste my time on the rest of them." A similar problem exists for filmstrips, slides, models, and textbook illustrations.

Improving Catalogs

Many catalogs are inadequate in one or more respects. In general, catalogs should be better indexed and be revised to make it easier not only to find particular films, but also to find the right combination of films, filmstrips, and recordings. They should be organized by functions and target audiences rather than by media. Catalogs should be at once more discriminating, critical, and specific. Instead of listing titles, they should include a good summary, critical comments, and specific recommendations.

We should aim for catalogs that will summarize research data and specify how much each film will contribute to learning if properly used on a given type of student. Just as data on reliability and validity are becoming mandatory in catalogs of tests, so data on teaching effectiveness should be given in catalogs of films.

The task of making a catalog is difficult because teachers do not agree on what they want it to include. Nevertheless, there is a lot known about the cataloging of graphic materials which could be drawn together and communicated. The Medical Film Institute in Chicago has made a good start in the evaluation of psychiatric and medical films and some psychological films. The Library of Congress and UNESCO are trying to bring together adequate data on what should be described about a film, how a film should be evaluated, and how catalogs should be set up. But we need a better flow of ideas into one central point—the Educational Film Library Association, the Library of Congress group, the U. S. Office of Education, the American Library Association, or one special working group set up with representatives from all of these. These ideas should be collected, organized, and disseminated.

Model catalogs should be developed and tested in different subjectmatter fields.

Exposing Teachers to Good Materials

Another problem is that of arranging for previews. Only about 20 percent of the teachers in this country get formal course

work in the audio-visual field. Most of them have no opportunity during their teacher education to see the key films, filmstrips, or slides in their fields. Their education in this respect occurs on the job, if at all.

Recommended sequences of superior material should be assembled and presented. Special interest groups, such as the mathematics teachers in junior high schools or the biology teachers in colleges, should address themselves to the problems of assembling these sequences. An increasing number of specialized teachers publications are containing sections dealing with graphic material. These publications can perform a great service by carrying reviews of such material, and periodic summaries of materials selected as among the best.

Publicizing the Best Things

Information on the latest and best developments in the educational use of pictorial materials should be disseminated to the teachers. For example, in the teaching of anatomy at the Duke University Medical School, the cadaver has almost been thrown out and the course has been supersaturated with all kinds of visual material. According to the latest report, none of the premedical students under the new system has ever flunked the State Medical Examination in anatomy.

New methods have been developed—e.g., repetitive loops which permit simultaneous or intermittent practice, the unclosed problem film, the stimulus film which requires responses, the use of a film as a test—but they have not been widely promoted. These excellent innovations should be widely publicized. The specialized professional journals could perform a great service by searching for and describing the most promising developments in their specialties. They could also give brief reports on cases of outstanding utilization of a film, indicating exactly how the film was used and what the outcome was. Some journals are already beginning to give their readers some of these services.

Need for Packaged Source Units

It requires considerable thought and effort to integrate graphic materials with the rest of the curriculum. This difficulty might be surmounted by preparing general source units in which the objectives were set up and in which the activities, reading materials, films, and other materials for achieving these objectives were recommended. No attempt would be made to dictate the experiences to be used in teaching; each teacher would be able to make the adaptations which would fit the source unit to his own pattern. The weakness of most source units at present is that they are paper units which have not been tried out. After the best advice has been assembled and the paper work has been completed, each unit should be tried out and modified in the light of experience. Only after that should it be recommended.

A Consolidation of Agencies into a Comprehensive Audio-Visual Center

In a recent article, Stenn (1953) points out that medical schools receive repeated requests for specimens, models, drawings, photos, exhibits, and various audio-visual aids, but have difficulty in locating the appropriate materials. After discussing the problem, he concludes that the creation of a centralized audio-visual agency suported by the medical organizations of the country would have a profound effect upon the dissemination of medical knowledge, modern and historic, and would stimulate research, teaching, and medical culture. As an example of cooperative achievement, he points to the success of the Midwest Inter-Library Center in Chicago, which receives literature and loans to 12 different universities supporting it. He concludes that a similar center should be set up for medical audio-visual material.

This excellent idea could be carried still further. We should consider the possibility of consolidating cognate agencies like Human Relations Films, Psychological Cinema Register, Teaching Film Custodians, Medical Films Institute, etc., into a single non-

profit center similar to the Educational Testing Service at Princeton, which is a successful consolidation of a number of previously separate testing services. Such a center could bring together in one national service the graphic material which is needed by educational institutions, publishers, and certain aspects of industrial and military training. It could deal with models, textbook illustrations, slides, filmstrips, phonograph records, and motion pictures. It should serve the following functions: (1) centralized cataloging and distribution, (2) the evaluation of materials, (3) stimulating and informally coordinating the work of local production units, (4) the production of critical materials which are not being made elsewhere, (5) carrying out of a certain amount of strategic applied and basic research.

This center should be supported partly by foundations and partly by the consumer. It should be established in connection with, but not as a part of, some major university.

Integration of Graphic Material with the Textbook

THE CONTENT and organization of most courses are determined by the textbook. Films and other pictorial media are most effective when integrated with the text of the teaching material. Therefore, it would be highly desirable to have textbooks written with the idea of using selected graphic material such as motion pictures and filmstrips.

Ideally, the graphic materials should be an essential part of the instruction; we should have an integrated package of textbook writing and illustration, motion pictures, slides, models, and filmstrips. Since the author cannot be sure that all of his readers would have all of these materials available, the first step probably must be to have them included as supplementary material. Suggested films, slides, and models (analogous to suggested outside reading and other projects) should not only direct the instructor's attention to the best visual material—thus circumventing some of the difficulties of using catalogs—but also should indicate when and how they are to be used for maximum effect.

Materials Should Be Tested

There is some danger, however, that the textbook would make too many suggestions, so that the teachers would be confused and not know what to select. We must avoid cluttering up the curriculum with more activities than any teacher can possibly carry on effectively. The only way to avoid such mental indigestion is to

test out a rough draft of the book and its supplementary materials by using them in a course, to make certain that the suggestions are actually practicable and effective.

Achieving Integration

The book is one of the greatest of human inventions—but the "snobbery of the book" is deplorable. Textbook writers often are highly verbal people who have little respect for the "audio-visual second-raters," and little training and aptitude for graphic communication. Moreover, texts are often illustrated by people who are not subjectmatter specialists. In general, the verbal presentation is planned first and then pictorial presention is tacked on. In addition, films are usually produced and sold by people who are not in the textbook business.

The ideal method would be to have a textbook writer who is also an expert in graphic communication. Failing that, we need intimate collaboration from the very beginning between the writer and the graphic communicator. They should go over the material and decide what can be best presented by the one medium, the other, or both. The textbook, its illustrations, the films and filmstrips, should be outlined together. Then the textbook writer should write the script for the film while the specialist in graphic communication is preparing the illustrations for the textbook. The result would be a completely integrated, maximally effective package, including the text, illustrations, filmstrips, and motion pictures.

Some Hopeful Steps in the Right Direction

A few publishers have begun to take bold steps forward. McGraw-Hill has been successful in the experiment of taking good textbooks, finding the concepts which are hard to teach, and making films to cover these concepts. Their book by Landis on *Your Marriage and Family Living* is a good example of graphic materials integrated with the text. Some of the illustrations in the text are

from a correlated set of motion pictures and filmstrips which were produced simultaneously with the book. Scott, Foresman is publishing high-school social studies books that are tied in with films and filmstrips. Certain publishers in the elementary reading field are using graphic materials in the teaching of reading.

But these tentative steps in the right direction are exceptional. Furthermore, the publishers have used chiefly the conventional types of materials rather than some of the newer types, thus indicating that they might be helped by expert advisory committees. It is to be hoped that these promising beginnings will continue to develop. If so, they will create a highly significant new trend among publishers of textbooks and will make an important contribution to education.

A Manual on How To Illustrate a Textbook

Because of the prominent role of the textbook in education, efforts at improvement should be concentrated on it. Our goal should not be to increase the mere number of pictures in textbooks, many of which are relatively irrelevant, but to increase the teaching effectiveness of the book by an increase in relevant illustrations.

A small manual on how to illustrate a textbook could be prepared for distribution by publishers to writers. This manual could answer key questions such as the following: What kinds of photographs should I use? What might the subjectmatter be? How large should the picture be? What different color processes can be used and what are the prices of these color processes? What are the sources of less stereotyped, warmer, and more realistic photographs? What should I specify in writing for a photograph? Which ones will I have to pay for and how much will I have to pay for them? What are the other kinds of illustrations I might use—diagrams, drawings, shaded drawings, caricatures? What are the common inadequacies in diagrams and how may they be avoided? What are the relative advantages and disadvantages of different kinds of illustrations?

A similar manual should be prepared on the importance of

integrating films, filmstrips, slides, and models with the textbook, and on how to do it.

A Conference of Top-Level Representatives

It would be highly desirable to get top-level representatives of publishing companies, specialists in graphic art, and educators together for a general free-wheeling discussion on a number of related topics. The group should include a research man, an artist, an advertising man, and someone who knows the technicalities of the printing business. This group should discuss topics such as the illustration of textbooks, the establishment of a central source file of illustrative materials, and the integration of the textbook with other instructional materials. It might initiate the production of the two simple manuals we have recommended. Such a discussion might also serve as a point of departure for significant research.

Acute Curriculum Problems

PLANS FOR improving the educational use of any technique, graphic or otherwise, must be considered in the broader context of the whole curriculum. It is often confusing and inefficient merely to thrust a new technique into an old curriculum. A new integration must be achieved. A considerable amount of effort has to be put into revising the entire outline of the course in order to reap the most benefit from the new materials.

Improper Use of Film

Even a good film can lose much of its effectiveness if not used properly. Too often films are used as "rainy day activity" to fill in gaps, or pictures may be shown when the teacher thinks the students or soldiers are too tired for anything else. Actually, the combination of fatigue and a darkened room favors not learning but sleep.

When films are not integrated with the curriculum, students are encouraged to transfer to educational films the passive attitudes developed toward entertainment films. They do not attend closely or try hard to learn. This type of misuse could be reduced by developing equipment which makes it easier for the teacher to integrate the film with his lectures and by dovetailing film and textbook. It could also be helped by the development of radical new ways of using films—e.g., with built-in test items—and by research data proving the superiority of such methods.

Overcrowding

Many teachers say they haven't time for graphic materials; there is already too much to cover. The crowded curriculum makes it hard to improve the quality of teaching.

Teaching has always been based on the concept of "covering the ground." Now the ground is becoming so expanded that it cannot all be covered. The great advances in all branches of knowledge have presented the curriculum planners with an extremely knotty problem. In American education we have not yet squarely faced the fact that we cannot study everything. Our compulsion not to leave out one important fact or idea leads us to treat many subjects superficially. We try to teach great numbers of discrete facts and are not very successful at teaching general principles. By always adding and never subtracting, the curriculum has become so crowded that it is becoming difficult to do anything but rote-memory teaching.

We need to go back, redesign the curriculum, and revise the syllabus, so that a feasible number of the most important things are handled adequately. We need to teach a high level of skill in a few key subjects such as reading, writing, and arithmetic. We also need to try to give the students a basic understanding of a limited number of key concepts and to help them to master and generalize these concepts through practice in applying them to a wide variety of situations. In science, for example, we should try to teach the scientific method (and a few important generalizations), instead of so many of the cookbook facts, formulae, and techniques of science. We should also try to teach a way of learning and to develop interests and attitudes so that the person can educate himself. It is relatively easy to specify these goals, but achieving them is as difficult as it is urgent.

Pressure To Pass Examinations

The pressure to pass examinations is a part of the curriculum problem. The power to test is the power to select the curriculum.

Most examinations are set in terms of words. If students must pass these verbal tests, particularly ones which emphasize the rote learning of facts, perhaps it is best to teach the students in the same way that we examine them—i.e., verbally. But, as we have already pointed out, there is reason to believe that a purely verbal examination of this type is not always the best measure of achievement. From this point of view, work could be done with the Regents' Examination or the College Entrance Board Examinations. Reactive as they are to evidence, the people who make these tests might notably improve them by including pictorial materials of proven value.

Clarifying Objectives

We need to clarify our objectives and evaluate our achievement of them. The moment we start defining what we want students to learn and then testing for it, we see that many procedures purported to get results don't get them. We are dismayed at the meager results and are moved to look for improved methods. Teaching procedures, including graphic devices, can be improved when we make certain by research that students are actually learning what they are supposed to learn. What are the specific kinds of behavior we want to produce? When we start testing for these habits and find we are not producing them, we begin to look for improved methods.

It is easy to get the machinery ahead of the objective—to divorce one's thinking from the instructional objective and believe that there is some magic in mere technique. One can do this with the textbook, the lecture, the film, television, or any technique. The better approach is to try to locate the fundamental educational problems (which certainly are acute!) and then to see how new techniques can help to solve them. Our initial question as to why people do not use more pictorial materials is converted into asking how these techniques can best aid in carrying on the education of our citizens.

Cooperation Between Educational Thinkers and Graphics Specialists

We need to have some people who understand the potentialities of audio-visual techniques, but who do not come as their specific representatives, as members of the most influential groups discussing fundamental educational policy. Key people throughout the educational system must be made to see how these techniques can help them to solve their problems. There is no single strategic place; a lot of people must be reached at many different levels. We must reach the movers and shakers, people often not in the limelight.

One step in the right direction which every campus could take is to form a committee on communication, including people from journalism, sociology, speech, psychology, audio-visual education, television, and related departments.

The University Film Producers Association is a young and dynamically growing organization. Nevertheless, the group has not yet realized its full potentialities largely because of the lack of interaction between film producers and educational thinkers. The emphasis must be not on the technique, but on the goals of education.

A New Look

In addition to examining the content of the curriculum, we need to take a new look at the entire educational process. Are we using our sharply limited supply of good teachers most effectively? How can we change the teacher's job to make it much more attractive to very able people? Are teachers devoting far too much of their time to tasks that could be done just as well by clerical assistants, sound motion pictures, and tutorial devices? How can we relieve teachers of these tasks so that they will be able to devote more of their precious talents to planning educational experiences and observing and guiding each individual student? Should the classes for some topics be much larger and those for others be con-

siderably smaller? Should the "homeroom group" be under the guidance of a Master Teacher and several clerical assistants and be enlarged to include a wider age range? These and other similar questions must be considered imaginatively if we are to realize fully the potential benefits of new methods of instruction. Without fundamental new thinking we will be unable to solve the crisis in education. Perhaps we are still asking ourselves whether we should alter the whip-socket on the horseless carriage at a time when we should be designing an entirely new vehicle and road system. We have been talking of enriching instruction by adding pictorial techniques to the textbook and lecture. But in many higher-level subjects, such as high-school physics, and in many schools, the choice is not between the sound film and the lecture, but between the sound film and *no instruction at all!*

The Teacher

OUR TEACHERS are and will continue to be the quintessential element in our educational system. They give as loyal and important service as the members of any other profession, but receive far less recognition and reward, and often are the targets for unfair criticism. The attitudes and training of our teachers will be the key factor in the success of any program for increasing the effectiveness of graphic communication in education.

The attitudes and procedures of the teaching profession have been molded by centuries of experience with the lecture and the textbook. The new graphic materials have no such sanctified tradition. Furthermore, they suffer by the transfer of attitudes generated by their popular use as media of entertainment.

Some teachers have negative attitudes toward graphic materials, produced by bad experiences. They happen to have tried a poor film, run into difficulties in finding the proper film, or been frustrated by equipment which was not designed for the needs of the classroom. Those who have tried graphic materials with bad results will have especially strong resistance. Therefore, we should be careful to avoid exaggerated claims which might lead to disillusionment. We also need to learn more about the scientific principles for optimal learning from graphic materials, and to apply these principles to the production of better materials, procedures, and equipment. In the long run, a superior product, properly used, exerts the strongest force against the resistances to change.

Technological Advances Increase Professional Rewards

Some teachers may be insecure and fear being replaced by the film. That such insecurity may be a source of resistance is suggested by Vernon's (1946) finding that it was the poorest teachers who failed to see any advantage in the use of motion pictures. Conversely, Nerden (1954) found that the film users tended to be the more highly cooperative teachers who assumed additional responsibilities both in the school and the community, conducted student-centered classrooms, and were accustomed to using all kinds of learning resources. These studies indicate that the generally better teachers tend to use the new pictorial techniques.

There is no actual danger that films will cause any teachers to lose their jobs. We have an increasingly acute teacher shortage. Teaching loads are too heavy. If part of the burden of instruction can be taken over by graphic techniques, the teachers will be freed for the more personal aspects of instruction which they alone can do. Teachers who use graphic aids efficiently are likely to become better teachers, more secure, and more satisfied in their careers.

Instead of thinking that the new graphic materials might detract from his role, the teacher should feel that having these materials at his disposal makes his work more interesting and effective, more important and dignified. The teacher in the modernized educational system which we envision will be relieved of much clerical work and drill, and set free to use his valuable training and talents in more significant roles.

The history of our country demonstrates dramatically that, when an occupation adopts superior methods which increase productivity, its standard of living, working conditions, and prestige are vastly improved. By boldly welcoming technological advances instead of timidly trying to restrain them, our country has provided a better life for all. That is the American way.

Teachers Selected for Verbal Ability

It is good that teachers tend to be selected for their high verbal ability. But with so much more verbal facility than their students,

it is natural that some teachers may not see the need for, or the special advantages of, visual material. A teacher who has devoted his whole life to the study of a certain subject, for example, history, will have such a rich background of familiarity with all of the details that he will be able to visualize and live his subject. He may not realize that his students lack this wealth of concrete background which is essential before words can be completely meaningful. In many cases the material, which is vivid to the teacher but shadowy for the student, could be quickly made real to the student by the proper use of good audio-visual techniques.

It is also true that many of us teachers have in us something of the egocentric ham actor who likes to hear the sound of his own voice and finds it difficult to step aside and let another medium, such as the film, put a point across. Most of us will agree, however, that it is good for students to participate in discussions. Howell (1954) found that, when a motion picture was used as a basis of class discussion, the ratio of student-participation to teacher-talking time was increased.

Snobbery of the Book and Lecture

In some quarters there is the mistaken idea that pictorial materials are somehow an inferior medium which is for the poor teacher or the low-grade student. Actually, research studies show (e.g., Vernon, 1946; Meierhenry, 1952; Nerden, 1954) that the better teachers get better results from films and the more intelligent students learn more from them. The better teachers also use more films.

It is a misconception that pictorial materials make no demand on the imagination and are necessarily less valuable for teaching abstractions. We believe that this view is based on a false dichotomy between the visual and the verbal. Visually-learned units may make words more meaningful. Furthermore, most graphic materials are used with words—photographs have captions, filmstrips are worked into lectures, sound motion pictures have a commentary, and graphic presentation may be the point of departure

for a discussion by the class. That the introduction of pictorial material does not necessarily produce an inferior type of learning is demonstrated in the careful study by Rulon (1933), which found that the superiority of the film group was greater on eductive than on rote items.

It is extremely important to teach students in such a way that they will be able to generalize their learning widely to cope with new situations. We need additional research to tell us how to improve this aspect of education. Some specific suggestions will be made in the section on scientific principles under the heading of "Specificity Versus Generality."

It Isn't Being Done

Even in certain fields, such as geography or art appreciation, where we would expect that the two-by-two color slide would be an indispensable tool for every instructor, we find persons, otherwise considered excellent teachers, who have not yet learned to make and use the color slide. Professors may use films and slides in their reports to meetings and extra-mural lectures much more frequently than they use them in their own classes.

Indeed, there are many professors who consider it beneath their dignity to use such materials. They seem to assume that this is calling for outside help in a way not quite consonant with their training and background. Furthermore, they may look askance at any method of teaching and learning which seems easy or pleasurable to the students. Unless it is somewhat painful, they mutely feel, it cannot be educational!

Combating the Entertainment Set

Because of the ubiquitous use of motion pictures and television for entertainment, some teachers and students tend to have the attitude that these media are for pleasant diversion rather than for serious learning.

Tests built into films, or given after the presentation of pictorial materials, can help to motivate students to a serious effort to learn.

An illustrated pamphlet on "How To Watch an Instructional Film" would be helpful. This pamphlet would be analogous to student guides on how to study or how to read a book. Although set up for students, such a pamphlet would also serve to influence teachers.

Similarly, a special introductory film or filmstrip could be prepared to establish the right attitude toward watching films and to show the students how to learn from them. Such a film should have a good market because it could be made general enough to be used in almost any course in which many films are going to be shown.

Information on How To Use Visual Materials

A parallel set of materials should be prepared specifically for teachers. An illustrated pamphlet on "How To Use Visual Materials" could stress scientific data on the advantages of using pictorial materials in teaching, along with hints on how to do it effectively. This pamphlet might go all the way from illustrations showing how to use the blackboard most effectively, to descriptions of the best ways of using catalogs and reviews to find pertinent pictorial material. Such a pamphlet could supplement audio-visual textbooks.

Another way of trying to get this type of material across to the teacher would be to devote an issue of a specialized professional journal to this topic plus a critical list of recommended materials. The experiment of having such an issue might be tried in one professional journal; if the idea proved useful, it could be spread to other subjectmatter specialties.

Finally, attention should be called to the useful films and filmstrips on topics such as how to make lantern slides and how to use the bulletin board.

Appealing to Professional Conscience

One way of motivating the teacher to use graphic materials is to appeal to his strong professional conscience by proving to him that using these materials will improve student learning. We need wider dissemination of the convincing results that we already have in a variety of fields demonstrating the instructional value of graphic materials. We need to gather together the scientific evidence to convince the teachers who agree that students can learn from films but believe that they do not learn as much this way as by more conventional methods. When we try to summarize the evidence for certain fields, such as English, mathematics, history, and music, we shall probably find that we need a good deal more research evaluating the *relative* effectiveness of graphic techniques for certain specific types of subjectmatter.

The appeal to the professional conscience should be made in the teachers colleges, via the prototype classroom, educational television, and all of the other avenues that we shall be considering in the rest of this book.

Improving Teacher Education

Although the pioneers in graphic communication have made substantial progress in a number of teacher education institutions, many teachers still fail to make optimum use of graphic techniques through ignorance. They do not know how to use these techniques and are unaware of their advantages. For example, a University of Wisconsin study (White, 1953) reports that a great proportion of secondary teachers who studied there did not even know what a filmstrip projector was. In other cases the teachers may know something about these new techniques but not enough to anticipate confidently using them with success. Two strategic places to work on improving this situation are the institutions where teachers are originally trained and the places where they return for refresher training.

Teacher Education Institutions

A prospective teacher ought to be taught the principles governing the effective use of films for instruction so that he can appreciate good films and use them more effectively. This is even more important with the other graphic materials. With the motion picture, some of the expertness of the producer is inherent in the film. With the other graphic materials, such as the blackboard and the filmstrip, the teacher has to supply these skills. At present, the teaching of these skills is largely an art born of practical experience. In order to facilitate such teaching, we need additional practical studies on all forms of graphic materials. Such studies are needed to translate the higher-level psychological principles into the sort of human-engineering recipes that can be taught rapidly to the classroom teachers in industry, the armed services, and the regular school system.

A rough estimate is that at present only 20 percent of practicing teachers have had a course in audio-visual methods. Furthermore, some of the courses, as might be expected, leave much to be desired. Prospective teachers are taught about graphic communication but not by means of it.

One can make sure that all teachers get some exposure to audio-visual methods by making it a requirement for teacher certification. This has been done in Pennsylvania and California. But most of us tend to teach in the same way that we were taught, rather than the way we were taught to teach. The student-teacher is more impressed by example than by precept. Teacher education institutions mold the habits of the future teachers, but there probably is no teacher education institution that uses graphic techniques throughout so that the apprentice teacher learns to appreciate these methods through repeated experience with them. Therefore, one of the most important tasks is to try to bring about the widespread use of superior graphic techniques in all teacher education institutions.

Some strategically located institution should be helped to

become a model which will set an example for others. Other efforts might be aimed at all such institutions.

In trying to approach our ideal, we run into the overcrowded teacher education curriculum. Like that of the rest of the educational system in our rapidly changing world, this curriculum needs fundamental re-thinking and reform.

Meanwhile, certain steps can be taken. As a minimum, each institution should have an audio-visual center and a consultant whose main job is to help professors to find or produce suitable materials for their courses. The ideal, however, should not be to tack graphic techniques onto the curriculum but to integrate them with the rest of the program.

A Survey Plus a Consultant Service

A new kind of survey could profitably be conducted with the goal of collecting information, facilitating the exchange of criticisms and good ideas, giving expert advice where wanted, and giving wide publicity to the best things that are discovered. A small group of people, who are experts on the curriculum as well as on audio-visual education, could travel around to make a sampling survey of what the educational problems are in teachers colleges and what is being done about using graphic techniques and other superior methods of instruction. The group should try to determine the following type of facts: whether the audio-visual specialists are working closely with the people who are concerned with curriculum materials, whether the course in audio-visual techniques is a gadgetry course or one which teaches solutions to educational problems, and whether the students are exposed to graphic materials only in this course or throughout. The members of the survey team should try to stir up general discussion of basic issues. They should give whatever advice is asked of them. Finally, they should write a pamphlet summarizing the most important needs and problems, publicizing the best things they saw, and suggesting the most profitable steps for the future. After a rough draft of this report has been written, they might call a conference of selected people from key institutions visited to discuss

it and recommend improvements. Such a project would probably cost between $15,000 and $20,000; we believe it would have far-reaching effects on the strategic institutions which train our teachers.

Summer Workshops and Refresher Courses

Summer workshops, or places where teachers come for refresher training, are also strategic spots. At these workshops, people who have already had fundamental training in education should have a greater opportunity to learn about graphic techniques and other methods of solving educational problems. Teachers in refresher courses should be exposed to the best materials and acquire the habit of using audio-visual catalogs and reading the right professional publications.

Improving Personnel in Graphic Education

We believe that the field of audio-visual education gets too many inferior people whose educational training and perspective is not broad enough. This field gets some unusually intelligent, inventive people with the imagination to see its great potentialities. But it also gets too many people who have failed elsewhere. Often the audio-visual coordinator is a person who was a relatively unsuccessful teacher but who is handy with a camera and knows how to run a projector. Often he is a gadgeteer rather than an educational leader with fundamental training in the curriculum and in the philosophy and history of education. Since there are few, if any, adequate courses of training leading to the PhD specifically in this field, the specialist is likely to be without a degree, to have low academic prestige, and to be put in a back room with the janitor. Too many in this field are given custodial status because they are second-rate; too many second-raters are attracted because of the custodial status; and a few first-class people push stubbornly ahead alone.

Broadening the Scope and Changing the Title

Instead of emphasizing the tool, we should emphasize the objective—improving teaching and learning. For example, the Brockport State Teachers College emphasizes the planning and production of a whole variety of solutions to teaching problems. One of their graduates, who refused to be typed as audio-visual specialist, is now working directly as the Assistant to the Principal in Charge of Improving Instruction. Schools do not employ "Directors of Words"; why should they have "Directors of Audio-Visual Education"? We wish to emphasize again that the problem is not the word versus the picture; different techniques have their advantages for different types of subjectmatter and typically the proper combination is better than any single method used alone. Furthermore, each separate teaching medium must be properly integrated into the curriculum. Therefore, the narrow craft of the audio-visual specialist needs to be drastically expanded into the role of the expert in instructional materials and special solutions to teaching problems.

Summer Workshops—A PhD

At present, we do not know of a single good place to send a student who wants fundamental training in the administration of a program of solutions to teaching problems as contrasted with the mere use of audio-visual gadgets. As a first step, a special summer workshop or course could be set up where those responsible for audio-visual work could come to discuss their mutual problems. Leaders of the workshop should be topnotch people who would not only bring the participants up to date on the best methods and programs in the field, but also help them to enlarge their perspective to include curriculum planning and other methods of solving educational problems. At first, a single workshop might be set up for audio-visual workers in especially strategic positions such as teachers colleges and universities. Later, a number of regional

workshops would be desirable for those responsible for administering audio-visual work at other levels in our school systems.

A second step would be to establish a PhD degree in an area which might be described either as "Special Solutions to Educational Problems" or as "Instructional Materials." The goal of this program would be to turn out people who would be specialists in all of the old and newer materials, who would know the history, philosophy, and psychology of education, and who would be sensitive to the whole curriculum area. Such a program would increase the prestige of the field and help to integrate the new materials into the instructional process.

New Fellowships

A few fellowships sufficiently substantial to elicit keen competition from the best people would be an excellent way of advancing the field. Ideally, these fellowships would be combined with the kind of PhD program we have just described.

We might also consider a new kind of fellowship, something like the fellowships which have recently been offered to help teachers improve themselves, but aimed at a wider social goal. These fellowships might be given to small groups, who would not only try to learn the best things for themselves, but try to survey the field and write a report which would make generally available the best things found. The work of each group might be guided by an advisory committee. The fellowships might be allocated by subject-matter and level. For example, one report might be made by a committee consisting of four English teachers, one each at the elementary, junior-high, senior-high, and college levels. The report should deal with all methods of solving teaching problems including the graphic methods. The plan should include provisions for skillful editorial help to make the reports interesting. This survey, as well as the somewhat similar one we have suggested at the teacher education level, would also supply valuable materials for the summer workshops.

Broader Perspective via Audio-Visual Journals

The audio-visual journals might help to broaden the attitude of the specialist toward his task by carrying articles on the general problems of improving education and knitting teaching methods into the curriculum. From time to time, they could present detailed descriptions of the best examples of broad, integrated programs at different educational levels and in different subject-matter areas.

Practical Demonstrations of Effectiveness

IT WOULD be desirable to plan several types of conspicuous demonstrations which might, on the basis of their merits, be dramatized and publicized.

The Prototype Classroom

A new type of classroom, which we shall call the prototype classroom, could serve two highly significant, related functions. One of these is the demonstration function, providing a place where teachers could go to see the very best and latest materials used with great skill by excellent teachers. Another is the service-testing function. Such a classroom could provide a place where the teacher has access to resources which are not now generally available and tries using these materials for periods of from four to six weeks. After such a service-testing period, the teacher would be in an excellent position to decide which equipment and materials are important for his own particular area and what modifications are needed in order to make them more useful.

Various teachers of different subjects at different grade levels could be assigned to teach in this room. A committee of experts should be available to suggest ideas for them to try and to help them to work out knotty problems they encounter. After sufficient experience, each teacher should ask about everything tried: "Did it get in the way of my teaching or did it help me?" The ideas that have clearly proven their value in this classroom could then

be adapted to existing classes in each subject and incorporated into the physical design of the new classrooms in any schools to be built.

In the beginning, the prototype classrooms probably should be of the conference type with equipment such as the overhead projector and push-button control of lights and projectors so that motion pictures or slides can be started and stopped from the front of the room. An opaque projector should be easily available. In other words, the teacher should be at no inconvenience in using audio-visual materials even for as short a time as 30 seconds. We estimate that approximately $4000 should pay for every conceivable thing that one might want in such a room, but an acceptable setup could be put together for approximately $2000.

We believe that 100 such classrooms, strategically distributed about the country, would be exceedingly effective in developing superior teaching ideas and disseminating them throughout our school system.

A Model Program in Psychology

Most university and teachers college students take an elementary course in psychology. Therefore, if a good program could be set up in elementary psychology, it would affect most people going through colleges, including future teachers, military leaders, industrialists, and the more influential, articulate part of the general public. Furthermore, such a model program would set a standard of excellence which other departments in the college might well be moved to emulate.

Psychologists should be particularly interested in this program since they are trained to be responsive to research results and many of them are especially interested in the problems of learning and teaching. The American Psychological Association might sponsor the project and seek foundation support.

First a representative committee would be appointed to formulate an over-all plan. This could be done during a summer workshop. The group could re-examine the goals of the elementary

psychology curriculum to decide which of them could be better realized if optimum use were made of the best materials. They could survey the needs for *all* types of teaching materials. They could examine the materials that are already available, decide what new ones are needed, and outline a program for producing them. For instance, a bright graduate student might be paid to spend a summer going over the films in the library of the Teaching Film Custodians (or scripts borrowed from the producing companies) for relevant psychological material. He might look at the pictures which seem suitable and assemble recommended samples of footage to be brought to a more expert panel for a final job of selection. To give a single example, he could assemble some sequences illustrating various emotions for use as demonstration materials. A given sequence might be edited first without any context and then repeated with more and more contextual material added, in order to demonstrate in a classroom experiment the role of various cues in identifying emotions.

Other materials—demonstrations, classroom experiments, and pictorial tests—would have to be produced. More than a dozen universities throughout the country have both reasonably good production units and good departments of psychology. If the efforts of these dozen universities could be organized into an over-all plan, an excellent series of materials could be produced. Such materials could raise the whole level of instruction in elementary psychology and set a high standard for other departments to emulate. Many of the new materials produced would be valuable for use on educational television.

Films Demonstrating Superior Teaching Techniques

It would also be valuable in different subjectmatter areas to make films demonstrating examples of recent improvements in teaching and contrasting them with the older methods commonly in use. The vivid example set by these films would help in the dissemination of the superior teaching which might or might not

involve the use of graphic materials. For example, as Wertheimer (1945) has pointed out, many geometry teachers present the proof for the formula for determining the area of a parallelogram in a relatively rote manner which does not lead to real understanding and does not transfer readily to new situations. Two films could be made, one using the all-too-conventional rote method and the other the superior method of logical learning. Then a demonstration experiment could be performed comparing the effectiveness of the two methods. Finally, the material could be edited to demonstrate the two methods to geometry teachers.

Such a project would serve two purposes: to show that learning by films is not necessarily more rote and specific than learning by other media, and to encourage geometry teachers to improve their methods of teaching. After these methods have been vividly demonstrated via the film, teachers could use them with the blackboard, cutouts, and other simpler media.

chapter 10

Securing Support from a Wider Audience

RESEARCH findings frequently do not reach the people who might use them, nor do they always come to them in useful form. There is often a lag of some five to 10 years between the research discovery and the general knowledge of the results by the ultimate consumer. Perhaps the research man is temperamentally unsuited for the marketing job and should entrust it to someone else.

These are the problems: What people do we most need to reach in order to have the greatest influence, and through what means may they best be reached? Is it most important to reach the teacher, the principal who is going to reward the teacher, or the person who controls the budget? What are the resistances of each of these kinds of people and which are the most important? As further investigation answers these questions, we can concentrate on the obstacles which are really causing the most trouble.

What Publications Are Most Important

We have talked about appealing to the professional conscience of the teacher; the real problem is how to reach the teacher with those facts which will stir his conscience.

Studies suggest that many teachers do not do a great deal of professional reading; their opinions on educational matters are gained more from the leading newspapers and news magazines than from any technical source. The audio-visual journals are per-

forming an excellent function, but these journals necessarily tend to reach specialists rather than the general public of teachers.

The readership of specialized journals is higher because the members join voluntarily and tend to be the best teachers. We believe that if teachers, and particularly high-school teachers, are to be reached through an educational journal, it should be done through their own professional journals—the trade journals of the English teachers, the social studies teachers, the mathematics teachers, etc.

Consumer targets should be identified and information packaged especially for them, e.g., the information that fades, wipes, and dissolves are often unnecessary is intended primarily for producers of film and only secondarily for purchasers.

We should not forget that a great amount of teaching is being done in industry. We should attempt to keep the people responsible for industrial training programs informed of the latest advances.

Reaching the Administrators and the General Public

Lack of funds is frequently mentioned as one of the barriers to improved teaching practices. If only we had the money, say the administrators and teachers, we could buy the projectors, films, maps, and other materials which we need. Part of the difficulty, however, is lack of motivation on the part of the teachers, administrators, schoolboard members, and parents to exert the pressure to get the money needed to buy these new tools. Teachers must be motivated to demand, and administrators and taxpayers to supply, the technical equipment needed.

Furthermore, teachers are influenced by their perception of what is expected of them by their principal, their superintendent, the board of education, and the parents. If these people are relatively indifferent, it is harder for the teacher to muster the extra effort needed to try new methods. But if these people are vitally interested, the morale of the teacher is improved; he is motivated to try the new methods.

Conferences should be sponsored, not for audio-visual specialists who are already convinced, but for key people, like superintendents, who are not. Once convinced, the superintendents can influence their teachers, make more money available for films, and support the production of more good films.

Although most of the education in this country is tax-supported, parents are not well-enough informed to demand visual education from their school systems. In fact, they are a little suspicious of it. Attempts should be made to show the public how graphic techniques can be used and what they can accomplish. If the parents become convinced that their children are not getting the best education possible, they will demand improvement.

Educational Television—Demonstrations of Effective Teaching

Commercial television is already a powerful force in our society; educational television is a rapidly growing infant. While we did not have the time at our conferences to do justice to this new medium, we do not underestimate its importance. Educational television by itself deserves a series of conferences by leading social scientists, educators, and technical specialists. While educational television will have certain problems of its own, such as the differences between teaching a captive versus a free audience, we would expect many of the issues discussed in this report to be relevant to teaching via television. Particularly pertinent should be the scientific principles for getting the best possible learning from graphic communication.

Topnotch demonstrations of audio-visual techniques over television are a way of reaching the teachers, principals, and parents. We can imagine a brief program showing what can be done, contrasting this with what is being done, and asking the question: "Are your children getting the best education possible?"

Initial steps of the right kind are already being taken. For example, the films of the National Education Association have been shown on many television stations. Television programs in

cities such as Chicago, Philadelphia, and Rochester are demonstrating modern teaching to the public. What we need is a more systematic series of presentations on a much larger scale. Such a series should illustrate all of the best methods and materials—library books, workshop arrangements, play facilities, maps, models, films, filmstrips, slides, pictures, animals being cared for, and plants growing. It should include the graphic techniques as one of a number of methods of improving teaching and helping to solve the current crisis in education. Ideally, a public-spirited, farsighted, topflight sponsor should be found to support the series on a national network. Certainly the crisis facing the education of our children merits presentation to the transcontinental television audience.

Need for Organized Exchange of Information

We have just been discussing the use of television to demonstrate the best teaching techniques to the public—a superior PTA meeting and visitors' day without having to leave your own living room. With a number of experiments of this general type being initiated at scattered places across the country, there is a great need for someone to bring together and evaluate the various things which have been tried and the lessons which have been learned.

We need to bring together brief summary statements about successful TV programs on education, indicating what they were trying to do, how they went about achieving it, and how effective the results were as judged by various means of evaluating the programs. We need to bring together information on common pitfalls, on types of programs which have failed and why. We need to collect the best materials in order to have them available as demonstrations for appropriate groups.

In the rapidly growing field of teaching specific subjectmatter via educational television, a similar plan for organized collection and dissemination of information would be extremely valuable. We hope that projects of this kind, to help those who are trying to

demonstrate superior teaching methods or to teach specific subjects, can be initiated by some suitable organization such as the Joint Committee on Educational Television, at Washington, D.C., or the Educational Television and Radio Center, at Ann Arbor, Michigan.

Value of Factual Surveys of Sources of Resistance

Pinpointing the sources of resistance to the optimum use of graphic materials in education is the first step toward finding ways to overcome those resistances. The preceding analysis of sources of resistance has been based on the judgment of our group supported by the relatively few factual studies which exist. In order to get a more complete picture, we should (1) solicit the judgment of others, (2) make a survey of those facts that are easily available, and (3) plan special studies to secure additional facts.

For example, as far as we have been able to discover there are no national data on the number of filmstrip and slide projectors in the schools. Several writers have noted such trends as the sharply increased general use of the two-by-two color slides and the increased specific use of filmstrips in teaching beginners of reading, but there are no exact data. Similarly, only a few studies have been made of the use of photographs as illustrations in teaching texts or of the use of other graphic materials such as maps.

Ideally, we need a comprehensive study with a carefully selected nationwide sample to determine the current use of graphic media in education. This study should include the use of photographs and diagrams in textbooks and the use of the blackboard, models, filmstrips, slides, motion pictures, and television in the classroom. It should not only include the extent of use, but also the judgments of sophisticated observers on the quality and adequacy of the materials. The plans for such a study should recognize that somewhat different characteristics are found in all of the following main areas: elementary education; secondary education; college education; industrial, military, and adult education programs.

Although a complete investigation of all graphic materials

would be desirable, studies with a more limited objective, such as the current status of the use of motion pictures in elementary or in college education, would be useful.

A considerable number of smaller studies of different parts of the problem at different times and in different geographic areas either have been completed or are now under way. It would be desirable to gather together and summarize the results of such studies. At the same time, a group of standard questions should be drawn up and recommended for inclusion as a part of all subsequent studies. If carefully formulated and criticized by experts, such questions could improve the quality, scope, and comparability of subsequent studies.

In addition to these broader, survey-type studies, there is a need for studies of a more analytical type. For example, Nerden (1954) found a biology teacher who believed that motion pictures were a very important aid to learning; his school had two projectors and yet last year this teacher didn't use a single film. The problem is to find out why.

In designing more analytical studies, we must remember that the teacher may not necessarily know why he doesn't use graphic techniques. He may have had experiences which he has never summarized in an "opinion." The right films may not have been available or the teacher may not have known about them. He may dislike to set up the projector and find it too time-consuming to thread the film; but if he is not aware that there is some more convenient way that these things could be done, he may not be able to identify this important source of resistance in himself. Relatively few people recognized the need for telephones until they were available.

Suitable techniques may be able to get at some of these unlabeled sources of resistance. As a first step, one might try to get from a relatively unstructured interview a fairly complete picture of the teacher's instructional activities, including a history of his experiences with graphic techniques and his attitudes toward them. On the basis of such interviews, one should be able to construct a more specific factual and attitude questionnaire to be given to a

larger sample. Some of the questions might be direct and some indirect. Another technique would be to suggest a new solution to some of the teacher's problems and solicit his reactions to this solution.

The experimental method also can be used to evaluate factors affecting the use of films. For example, we could try setting up a situation in which the projectors and prints are more easily available and see what effect this has. One approach is to set up an ideal situation, minimizing all the factors which we now believe are responsible for resistance, and then see how much more use we actually would get. Another approach is to try to vary factors one at a time. In designing such experiments, we should watch out for the "novelty" or "experimental-set" factor which has been found to be important in work such as that of Roethlisberger and Dickson (1941).

To summarize, the following steps are suggested: (1) determine fairly well what the major resistances are; (2) estimate what must be done to remove each one of them, and what it will cost; and (3) act on the ones which seem most important and feasible to remove.

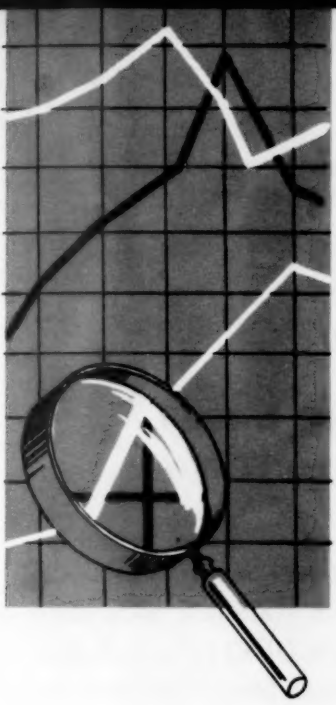
Correcting Lack of Industry Support of Research

The visual face of education would be vastly different if the relevant companies—Eastman, Dupont, RCA, Western Electric, Westinghouse, General Electric, and others—had invested in functional communication research one-quarter of the amount which they have spent on related engineering developments. In the area of psychological and social science, the communications industry lacks a research tradition; it seems to be unaware of the need for this kind of research. For example, a great deal of money has been spent on developing a new color film process, but not nearly as much on how to make films useful in teaching. But research on teaching might increase sales more than the color process. Similarly, *Life* magazine has spent a great deal of money on the devel-

opment of mechanical production methods, but, as far as we know, has never spent any research money on the impact of the picture.

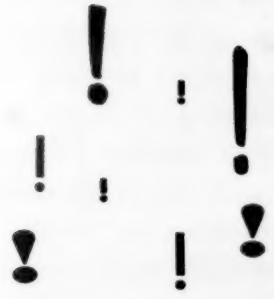
In contrast with the communications industry, the life insurance companies have a cooperative organization, the Life Insurance Agency Management Association, which sponsors industry-wide social science research. This organization started modestly with six companies, each contributing $1500 a year. Now more than 200 companies participate. This cooperative research association has produced results of the highest practical value in the day-by-day task of selling life insurance.

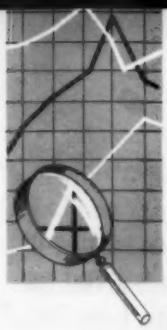
The motion picture industry, the photographic industry, pictorial magazines, manufacturers of television sets, and perhaps advertisers, should form a similar cooperative organization to sponsor research on graphic communication. Perhaps such an organization could also help to support the kind of a comprehensive audio-visual center which we have already recommended. A top-level conference of educators and industrial leaders should be called to explore the possibilities of securing general industrial support for both basic and applied research on graphic communication.



part II

SCIENTIFIC PRINCIPLES FOR MAXIMUM LEARNING FROM MOTION PICTURES





chapter 11

Need for Research Guided by Theoretical Analysis

LEARNING is not inevitable. In order to produce efficient learning, good materials must be used in the right way. For example, Jaspen's (1950) study, which we have already described, showed that the poorest version of a given film, which was comparable with many films used today, taught only 46 percent of the students to perform a task while the best version taught 98 percent. Why are some films much more effective than others? Discovering the scientific answer to this question will help us to improve teaching.

We have already seen that the application of graphic techniques to education is a part of the general problem of the curriculum. Similarly, the problem of discovering fundamental principles of graphic communication is a part of the general problem of the psychology of perception, motivation, and learning. Discovering more about fundamental principles will help us to improve all media and should tell us under what conditions one medium will be superior to another.

We believe that the greatest advances in graphic communication are likely to come from basic research of a theoretical-analytical type at the pure science level. Completely empirical comparisons of different media in a given situation can yield results which are largely an artifact of unspecified characteristics of the particular representatives of the media which the experimenter happens to use. Such results tell us little about the inherent properties of different means of representation. A better thoretical

analysis of how people learn from pictures and words will help us to design more discriminative experiments.

There is a great need for more discriminative experiments. After a thorough survey of over 30 years of work, Hoban and van Ormer (1950) conclude: ". . . we are impressed with how little discrimination has actually been developed with reference to the various factors or processes that influence audience behavior by means of films."

In performing research on communication, it is often advantageous to use an exactly reproducible medium like the motion picture. The problem is to find an experimental situation in which one can always get a measurable and controllable effect. Then one can study how different variables change this effect. Unless we use the situation to analyze the influence of basic variables, we are subject to the criticism that research on motion pictures simply shows what has been known for a long time, namely that people can learn from them. We must go beyond this and design analytical studies showing how specific factors influence the effectiveness of learning (Lumsdaine, 1947; Carpenter, 1948).

Since the motion picture is flexible and reproducible, it has been convenient to concentrate most research on this medium. It should be possible, however, to generalize many of the principles derived from research on the motion picture to other forms of graphic communication. Each generalization must be tested by experiments on the new media, but it is much easier to make the critical tests after the principle has been discovered and clarified by work on whatever medium is best adapted to research on the variable being investigated.

At present, most research on graphic communication media is supported by the Armed Forces. To have the military responsible for such a large majority of the research on a fundamental aspect of education is not healthy. Military purposes are necessarily too specialized to bear the brunt of responsibility for such a basic educational problem. Also much of the present military emphasis is on research that is likely to have a fairly immediate application. Each organization sponsoring research must justify itself annually

by what it has done that year. The basic research which usually produces the greatest long-run results tends to be neglected because its importance is not so well understood. There is too much emphasis on specific applications and too little on general principles.

This problem is part of a broader one. Both industry and the Armed Forces have learned that basic research in the physical sciences will pay off in the long run, but they have not yet had time to become convinced that basic research in the newer social sciences will pay off. Therefore, they support long-range, basic research in the physical sciences but only short-range applied research in the social sciences. But it is just as true in the social as in the physical sciences that many of the most important and practical applications stem from basic advances in knowledge produced by pure science research.

Plan of the Following Discussion[1]

Since the basic principles of effective teaching-learning with graphic communication seem to be the same as with other media, we shall group the variables involved according to certain fundamental factors of teaching-learning which are:

Drive (motivation)—the student must want something.

Cue (stimulus)—he must notice something.

Response (participation)—he must do something.

Reward (reinforcement)—he must get something he wants.[2]

Finally, we shall discuss a number of research problems and practical principles which do not fit neatly under any one of the foregoing factors.

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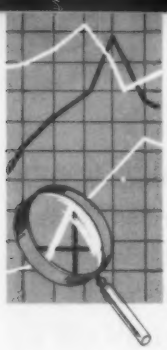
[1] Miller takes responsibility for the theoretical organization of this section and for any shortcomings which it may have.

[2] These factors are illustrated in a film by Miller, N.E., and Hart, G., *Motivation and Reward in Learning*, 15 min., sound, black and white, Psychological Cinema Register, Pennsylvania State University, University Park, Penna. For further discussion of these factors and of significant details of the learning process, see Dollard and Miller (1950) and Miller (1958).



chapter 12

Drive: The Student Must Want Something

A NUMBER of studies show that the viewers of motion pictures are not merely passive but that they can react with strong internal emotional responses, which have a motivating effect. Dysinger and Ruckmick (1933) showed that viewing motion pictures can arouse psychogalvanic responses and produce pulse changes characteristic of strong emotional response. Kleitman (1945) showed that temperature was increased immediately after seeing a motion picture. Renshaw, Miller, and Marquis (1933) showed that seeing a motion picture tended to affect the pattern of behavior during sleep, sometimes for more than one night after seeing a picture. All of these findings are evidence for the fact that motion pictures can arouse strong drive-producing responses. Furthermore, on the basis of a number of studies summarized, Hoban and van Ormer (1950) suggest that motion pictures can motivate students to spend more time on outside reading, special projects, art work, and the like.

Less Knowledge about Influencing Motivation than Communicating Information

We know much less about teaching motivations and attitudes than about teaching factual knowledge. This is true for all media including pictorial techniques. It seems likely that we will have to distinguish clearly between the objective of imparting knowledge and that of influencing motivation, because it is by no means certain

that the short, specific straightforward kind of film which is economical for imparting knowledge will be the best for influencing attitudes and motivation.

Importance of Knowledge about Influencing Attitudes and Motivation

During World War II, a whole series of fabulous films were made by the Hollywood producers with the idea that these would certainly influence the attitudes and morale of the troops. But, in contrast to the large gains which the films produced in factual information, Hovland, Lumsdaine, and Sheffield (1949) found less effect on opinions and little, if any, measurable effect on more general attitudes and motivations. This lack of effect may be partly a defect in the instruments of measurement that were available, but it is quite possible that the huge expenditure of money and effort going into this attempt to influence attitudes was largely wasted.

Today, the United States Government is spending approximately 100 million dollars a year attempting to create respect throughout the world for free enterprise and the principles of democracy. It seems highly probable that we could improve considerably the effectiveness of this program, which is so vital to the struggle for democracy, if we had a better scientific understanding of how to affect motivations and attitudes, especially in foreign cultures.[3] Specifically, a 5 percent (i.e., approximately 5 million dollar) investment in research would almost certainly produce far more than a 5 percent gain in effectiveness.

We desperately need to make a general theoretical-experimental attack on the problem of influencing motivation. This attack must include the development of better techniques of measurement. As a first step, a group of people might be assembled for several weeks of discussion. The group should include specialists in graphic communication, but also people representing other skills, such as

[3] See Williams (1953) for a discussion of the communication of information in the underdeveloped areas of the world.

learning theory, advertising, propaganda, and psychotherapy. The time is right for a clarification of issues and a formulation of some tentative hypotheses.

Some Hypotheses about Changing Motivations and Attitudes

The following hypotheses are put forward as examples of the type which should be investigated:

1. The motivational effects of a film are dependent upon the learned drives which the viewer already possesses.[4] A motion picture cannot create a primary drive such as hunger, pain, or thirst. Its ability to arouse motivation is dependent upon the learned drives which are already attached to the pictorial and auditory cues presented, or to the thoughts which they arouse. An understanding of this principle should help producers and users to avoid the disappointments which are in store for them if they expect the impossible. It should direct their attention to the conditions which must be met if the film is to arouse motivation.

2. The motivation aroused by films must be reinforced in daily life. This is a corollary of the preceding point. To be effective, the motivations involved in films must build on, not run counter to, those in the life experiences of the members of the audience. If the message of the film is confirmed in real life, the effectiveness of successive films will be increased; if it is not, the prestige and effectiveness of the film as a medium will be decreased. It will be impossible to change basic attitudes and motivations if the situation represented in the communication conflicts with the life experience of the audience.

3. Whenever the conditions of life are different for different audiences, their motivations will be expected to vary. Thus different types of appeals will have to be made to different audiences. Some of the main dimensions in which audiences in our society may vary are: age, sex, level of formal education, intelligence, social

[4] For a more detailed discussion of learned drives, see Miller (1951) and Dollard and Miller (1950).

class, geographical region, and ethnic origin. Audiences from a foreign culture will be expected to differ more widely.

4. One way of arousing a motivation for a given action is to show that it is a means to a goal that the subject is already motivated to achieve, or a way of avoiding a consequence that the subject is already motivated to avoid.

5. It is more difficult to motivate people when the reward or punishment for action will be delayed. In training camps, there was no apparent interest in the film "Land and Live in the Jungle." When soldiers were flying over a jungle territory, there was a great interest in this film.

6. The motivational effect of a communication tends to dissipate with time; if possible, it is best to apply your motivational stimulus immediately before you want to get action.

7. Motivation and attitudes can be conditioned and deconditioned. For example, if a Negro is repeatedly represented as a doctor, in situations in which the positive responses to the symbol of doctor are stronger than the negative ones to the color of the skin, this experience will tend to extinguish the unfavorable responses to the dark skin and to condition more positive ones. In order to clarify this hypothesis, the variables found to be important in other conditioning studies should be systematically studied in an attitude-change situation. For example, we should investigate the effects of the strength of the "unconditioned" drive, frequency, and the sequence and spacing of conditioned and unconditioned stimuli.

8. Repetition is needed but experimental extinction (negative adaptation or boredom) must be avoided. Unless the film-maker has very strong motivations at his command, we would expect that a considerable number of repetitions would be required to attach an appreciable amount of motivation to any new cues, for example to build up a strong appetite for studying history. Since the particular cues used to arouse the motivation are not reinforced by any primary drive during the showing of the picture, we would expect that there would be some tendency for them to extinguish and become weaker with repetition. Indeed, experimental evidence

indicates that in general the emotional effects of a film are reduced by immediate repetition. Learning theory suggests two ways of achieving repetition without running into this reduction in effectiveness: one of these is spaced practice with long enough intervals between trials to allow spontaneous recovery and/or reinforcement in real life to occur. The other is to find a variety of quite different cues that will arouse the same motivation and to use a different one of these as the "reinforcement" in each repetition.

9. The summation of a variety of different compatible motives should be more effective than any one of them taken alone. We need more research on the ways in which different drives either facilitate or conflict with each other.

10. Some motivations and attitudes are much harder to change than others. We need to discover how to specify the factors which make motives hard to change so that we will not try to achieve difficult ends with insufficient means.

11. For the factual informational type of film, the intent of the producer should be made clear to the audience, but for a propaganda-type film to have the greatest effect, the intent of the producer should be concealed.

12. Identification with the hero facilitates adopting his motives and attitudes. Although the concept of identification probably points to an important effect, it is somewhat vague and may have to be sharpened before it can lead to significant research. Miller and Dollard's (1941) theory of imitation is a step (albeit all too short a one) in the right direction. This theory of imitation leads one to expect that more motivation will be aroused when the actors are similar to people whom the students have been rewarded for copying. In general, these will be people of high prestige, unless the prestigeful people are completely out of the range copied by the audience. If the characters portrayed are completely unfamiliar to the members of the audience, we would not expect them to have any habits of copying such protagonists, and hence would expect little motivational effect. Perhaps this is one of the reasons why Holaday and Stoddard (1933) and Sturmthal and Curtis (1943) find that familiar settings seem to help learning from instructional

films. Studies by Hoban (1953, 1953a) and Hovland, Janis, and Kelley (1953) support the hypothesis that identification with the protagonist is a significant variable. It would be interesting to investigate the relationships between the spatial perceptions evoked by the film and identification, for example, determining whether or not identification would be facilitated by a judicious use of the subjective camera angle which tends to evoke in the viewer the same spatial perceptions that he would have if he were the protagonist. This effect is intensified in wide screen projection.

13. Whenever fear is used as a motive, it is important to point out very clearly the appropriate ways of avoiding the danger and escaping the fear. Any response which leads to escape from fear or punishment is reinforced (Miller, 1951). If the communicator does not provide desirable means of escape, the audience will find undesirable ways—looking away from the film, paying attention to something else, belittling or forgetting the communication (Miller, 1950). Recent studies reported by Hovland, Janis, and Kelley (1953) support this hypothesis.

Expanding Range of Motives Studied—Intellectual Curiosity Versus Fear of Being Different

Most of the basic research on motivation to date has been confined to a limited number of so-called primary drives such as hunger, thirst, sex, and pain. As we have seen, these are not the drives which can be directly manipulated by graphic communication or are usually important in the classroom. The motives which are significant for education are described by phrases like intellectual curiosity, the desire for approval, and the motivations to pay attention and to rehearse, to achieve, to solve problems, and to have a logical explanation. The very description of these motives is necessarily vague and inaccurate because we know so little about them. There is great need to expand basic research on motivation to include these little-understood but highly important motives.[5]

[5] See Dollard and Miller (1950, pp. 86-94; 116-123; 263-267) for a discussion of the role of such motives in the higher mental processes and in psychotherapy. See also the discussion of "New Trails for Research on Motivation" in Miller (1958).

Many of the foregoing types of motivation have been called *learnable drives* (Miller, 1951) because they are subject to modification by learning. This does not mean, however, that they have no innate basis or that they are in every case solely the product of learning. In fact, one of the important problems is to discover the innate, physiological mechanisms of these motives. Another important problem is to find out how these motives can be directed, strengthened, or inhibited by conditions of learning. For example, what are the principles describing how intense curiosity in intellectual subjects can be developed? How can one avoid inhibiting creativity by developing a strong fear of being different? How can educational films best arouse and use the highly significant motives of curiosity and problem solving?

Work on levels of aspiration, group dynamics, attitude change, and psychotherapy is increasing our understanding of a wider range of motives. Readings selected by McClelland (1955) give a sample of some of this work. Studies by Berlyne (1954), Harlow (1953) and his students, Montgomery (1954), and Myers and Miller (1954) show that something which might be called "curiosity" or "exploratory drive" is a strong motive in mammals and can be studied experimentally.[6] These studies open up the possibility of analyzing under controlled conditions the variables relevant to such motivations. An acceleration of this line of research and its extension to other types of motivation at the animal, child, and human adult levels promises to yield educationally significant principles. Certainly our present list of experimentally studied motives is far too short!

Need for Better Measures of Motivation

A primary difficulty in research on human motivation and attitudes is the lack of suitable measures.

The motivations that are modifiable by various media of communication are the learned, rather than the innate drives. We know

[6] Only the most recent studies are cited; these contain references to earlier ones.

that learned responses can be quite specific to a given type of stimulus situation; the same seems to be true of learned drives. Therefore, in trying to measure learned drives, it is important to be sure that all crucial aspects of the measurement situation are similar to the actual situation in which we expect the motives to operate in real life.

As Dollard (1948-49) has pointed out, the halo of validity from the success of polls in predicting elections may be misleading because the test situation in polling is so similar to the real situation in voting. The danger of extrapolating to dissimilar situations is illustrated by a study by Bennett (1952) who used some of the group dynamics techniques to increase the motivation of students to volunteer for a psychological experiment. By so doing, she was able to increase the number of people who raised their hands to volunteer from 10 percent in the control group to 90 percent in her best experimental group. But the percentage of people in the different groups who actually showed up for the experiment was almost exactly the same—10 percent. That is, she was able to vary the motivation for raising the hand in a social stimulus situation, but unfortunately this stimulus situation happened to be quite different from the one in which the student was alone in his own room and had to decide to start toward the laboratory. Apparently, the factors that increased the motivation in the measurement situation were not transferred to the performance one; the learned drive with which she was dealing seemed to be quite specific to the cues in the social situation. Similarly, the classical studies by Hartshorne and May (1928) showed that school children's motivation to be honest is surprisingly specific to a given type of situation; they found little evidence for any general trait of honesty.

The foregoing theoretical analysis and empirical evidence emphasize the dangers of indirect measures of motivation. We must measure the actual payoff behavior in the real situation. If we use an indirect measure, it must be validated against the behavior it purports to predict. Too many studies of attitude change, which are otherwise technically slick, have used paper-and-pencil, or polling-type tests which have not been validated.

A good example of using the actual behavior in the real-life situation to measure a motivational effect is reported by VanderMeer (1953). The study compared the effect of two types of personal hygiene films—one of them a straight lecture presentation, and the other a jazzed-up version with folk music in elaborate Hollywood style. The effects of the different versions on the two groups who saw them were studied by recording their purchases of toothpaste and toothbrushes, observing whether or not they washed their hands after going to the toilet, and a variety of other ingenious behavioral techniques. The results showed that both versions were equally effective.

If reliable techniques for measuring motivational effects can be perfected, we can use them to compare the effects of various procedures and to discover more about the laws of motivating people.

We also need to develop techniques for measuring the student's moment-to-moment interest in different parts of a film. Then we should correlate the student's level of interest with his retention of the material presented. Some preliminary work has been done on this problem by Twyford (1951). Using the Film Analyzer developed at the Pennsylvania State University, he found a relatively high correlation between actual learning and prediction of learning by students, but a negative correlation between actual learning and "liking" for the film.

Effects on General Emotion or Mood

We have been discussing motivations to do specific things, such as using toothpaste. Another problem is the measurement of the general level or type of motivation or mood—e.g., anxiety, hostility, depression, or euphoria. For example, Ruesch and Prestwood (1949) found that when they played a tape recording of an interview with an anxious patient, the anxiety was so contagious that the listeners got upset and jittery, started quarreling with each other, and tended to leave the room. In this case, the material on the tape was not changing anybody's attitude toward any specific

thing; it was influencing the general motivation or effect. Similarly, Nowlis (1953) reports that the group working at Rochester has been able to use small doses of certain drugs to manipulate moods—for example, to make college students more withdrawn or more outgoing, more anxious or less anxious. They have devised techniques (self-rating, partner-rating, observer-rating, and adjective check list) for reliably measuring these effects.

It is a commonplace observation that a motion picture can affect one's mood. At the beginning of this section we cited a number of studies which used physiological techniques—psychogalvanic responses, pulse changes, etc.—to demonstrate marked effects. Those techniques measured the strength of the effect; the techniques reported by Nowlis tell us something about its quality—whether it be erotic arousal or anxiety. We should be able to use both kinds of techniques to make scientific studies comparing the effectiveness of different variables in a film. Such studies should clarify the laws involved in using pictures to influence moods.

Motivating Students To Learn from Films

Learning requires effort and must be motivated in order to be efficient. A transfer of the attitudes generated by entertainment films probably has obscured this point as far as educational films are concerned. The effectiveness of training films can be improved if more attention is paid to motivating the students to learn.

Some Motivation Can Be Built into the Film

Suitable material in the introduction and elsewhere in the film should help to motivate the student to learn from it. In preparing this material, the hypotheses in the first part of this section are relevant. There is some evidence suggesting that a suitable introduction in the film may improve its effectiveness, but this is an area in which much more work needs to be done.

Role of Examinations in Arousing Motivation

One of the stronger motivations acquired in school is to do well on examinations, to get good grades. Thus it is not surprising that warning the students in advance that they will be examined on the content of a film or filmstrip can have the effect of increasing their learning (Hovland, Lumsdaine, and Sheffield, 1949). We would expect this effect to be greater with students who would otherwise be poorly motivated than with those who are already strongly motivated.

Role of Teacher in Arousing Motivation

It is generally conceded that a good teacher can have the important effect of interesting the students in the subject and arousing their general motivation to do well. Thus it is not surprising that in Vernon's (1946) study, it was found that students in classes with a better teacher showed more learning from a film, even if the teacher had nothing to do during its presentation. This correlation suggests that the good teacher may have created a higher level of motivation to learn. Similarly, the parents will have an important role on the student's motivation to learn which should affect his learning from films as well as from other classroom methods. Thus, as Davis (1948) has shown, we must expect different motivational problems to be encountered in children from different occupational and social classes.

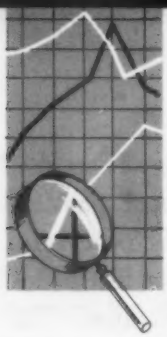
Finally, Allison and Ash (1951) have shown that telling students that the material in a film is important and difficult improves their learning.

Drives Should Be Relevant

Drives which are reduced by performing the correct responses (e.g., paying attention and rehearsing) should reinforce learning. Drives which are reduced by incorrect responses (e.g., fatigue re-

duced by relaxation) should interfere with learning. Therefore, films should not be shown to fatigued men under poor physical conditions. When the topic is dramatized, we should be careful that this does not introduce irrelevant drives. There is a distinction between interest in a film and interest in the subjectmatter. The entertainment film is primarily concerned with the former, the instructional film with the latter. We should ask ourselves what response we want to motivate—continuous passive looking, attempting to remember, or attempting to understand. Does a specific dramatic effect introduce relevant or irrelevant motivation? Is there a certain level of tension or anxiety which is optimum for a specific kind of learning? We need further studies to supply more exact answers to such questions.

The motivation to be entertained and relaxed by viewing films, a transfer from their widespread use as entertainment, should tend to interfere with learning from them. The more experience students have had with properly used training films—the more they have been motivated and rewarded for learning from them in the past—the more they should be motivated to pay attention to and learn from them. Therefore, we should expect a beneficial, cumulative effect from the increasing use of good training films.



chapter 13

Cue: The Student Must Notice Something

IN ORDER to learn, one must notice something. Learning is the connection of responses to new cues. Learning can also involve acquiring discriminations which make responses more specific to the correct cues.

The cues involved in learning can be quite subtle and complex —for example, the slight signs of restlessness which indicate that the salesman is not interesting his client and should try a different line of approach. Some of the older stimulus-response psychologists have given too narrow a definition to "stimulus" or "cue." Any specifiable attribute of the environment, which the Gestalt psychologists or other students of perception discover as a consistent basis for discrimination, can appropriately be called a cue. Changes, differences, the direction of differences, the size of differences, patterns, and gradients of size and texture can be used as cues. Man has a marvelous capacity to learn to respond to intricate and subtle relationships and patterns.

Motion Picture's Supremacy in Visual Cues

The eye is an extremely important sense organ especially adapted to making a wide variety of accurate discriminations. In man, it is estimated that approximately half of all the sensory nerve fibers in the whole body come from the eye. The motion picture is the way *par excellence* of presenting visual cues. This means that where vision is an important part of the real-life situa-

tion, the motion picture should be an important educational medium. It also means that the motion picture should be designed primarily to exploit topics that lend themselves to visual presentation. Common sense as well as expert opinion agree that one of the important advantages of the motion picture is its ability to present relative motion. But Lumsdaine and Sulzer (1951) have shown that it can have advantages also where animation techniques can be used to direct attention to the crucial cues in an essentially static subject, such as how to read a micrometer.

Effects of Various Modalities

Let us define a *relevant cue* as one to which the learner should respond in order to have the most efficient habit. Then, the relative effectiveness of stimulus presentations via various modalities should depend upon which one contains the most relevant cues for the particular materials involved. Since many of our relevant cues are visual, we will expect vision to be important, but the relative importance of different modalities will vary with the nature of the learning task. If relevant cues (especially, variable relevant cues, that are sometimes present and sometimes absent) come from a number of modalities, we will expect the use of two or more modalities to be more effective than the use of only one. Evidence from a number of experimental studies summarized by Hoban and van Ormer (1950) shows that a combination of visual and auditory presentation usually is better than the poorer of the two used separately and sometimes better than either. Similarly, Gibson (1947) found that verbal descriptions of visual shapes were a help in learning the identification of aircraft.

A number of studies have compared films seen only, heard only, and both seen and heard. Most of these studies are probably somewhat unfair because the films originally were constructed to be both seen and heard.

A more useful dichotomy than the visual versus the auditory is the contrast of pictorial and verbal presentation. While pictorial material is necessarily visual, verbal material can be presented

visually in a book or caption, or aurally in a lecture or sound film.

A somewhat similar and useful distinction is that between conventional and nonconventional surrogates as described by Gibson (1954). The relationship of the conventional surrogate, such as a word, to its significate is largely one of arbitrary social custom; that of a nonconventional surrogate, such as a picture, depends on stimulus similarity.

As we have already pointed out, however, words are usually used with pictures. For example, in a newspaper, a picture of a family whose house has just been burned seems more effective if it is labeled as a local family and other significant details are given.

Summation Versus Interference of Cues

When cues from different modalities (or different cues within the same modality) are used simultaneously, they may either facilitate or interfere with each other. When the cues elicit the same responses simultaneously, or different responses in the proper succession, they should summate to yield increased effectiveness. When the cues elicit incompatible responses, they should produce conflict and interference. For example, one would expect the commentary of a film to be a help if it directs the attention to the relevant cues and elicits relevant responses, and a hindrance if it distracts from the relevant visual cues or elicits competing responses. Similarly, stimuli which are inserted in a film to arouse interest may distract from the main point.

Research on the Sound Track

With the advent of the magnetic recording projector, (which has a stripe of magnetic material in place of the optical sound track, and records and erases with the flexibility of a tape recorder), it is extremely easy and inexpensive to do research on the sound track. This would be a good type of research for small university groups. For example, Chall and Dial (1948) have shown with radio news-

casts, and Allen (1952) with instructional film commentary, that the readability of the commentary influences the factual information learned from the communication. Jaspen (1950) and Zuckerman (1949) conclude that sound tracks can err by trying to present either too much or too little material. More analytical studies are needed on these variables. Other factors should also be investigated, such as the conditions determining whether it is desirable for the commentary to lead or to follow the action in the pictures.

Realism—How Pictures Are Perceived

We believe that applied research on graphic communication would benefit greatly from a more adequate pure-science theory of how pictures are perceived and how people learn from them. As a step toward such a theory, the following tentative analysis is advanced.[7]

A basic principle in stimulus-response learning theory is *stimulus-generalization*, namely, that a response learned to one cue can be elicited by other similar cues. Stimulus-generalization occurs in a *gradient;* cues more similar to those in the original learning situation have a stronger tendency to elicit the learned response. In the case of a perfect picture viewed with one eye from the proper fixed point of view, the pattern of light falling on the retina is identical with that which would be produced by seeing the original object or scene through an aperture limiting the scope of vision. Since the visual cues are identical, we would expect perfect generalization of any responses which the original visual cues would have elicited. It will be impossible for the person to tell whether he is looking at the picture or the real thing; he will respond in the same way to both. But this does not mean that the person will respond appropriately to the picture, or in other words, understand it. If he did not have appropriate responses to the real object or scene, he will not have appropriate responses to the picture.

[7] See also Gibson's (1954) thought-provoking presentation of a theory of pictorial perception. Discussion with Gibson at the conferences has contributed, of course, to the hypotheses presented in this report.

As the cues in the picture become more different from those in the original scene, the amount of innate stimulus-generalization will be reduced. Differences between the real scene and the picture can be produced by the fact that (a) certain cues, such as color, binocular perspective, or movement parallax, and the context provided by a wide scope are omitted from the picture; (b) other cues, such as the edge, the frame, and the texture of the picture's surface are added; and (c) certain distortions in perspective, shape, and relative size are produced if the picture is not viewed from the single point in space which yields an undistorted projection.[8] The greater the differences, the less the generalization.

If the responses which generalize to the picture are rewarded, we will expect them to be strengthened. In this way, the decrement produced by stimulus-generalization may be overcome. But if the responses which generalize to the picture are not rewarded, we will expect them to be extinguished. The decrement produced by stimulus-generalization will be increased; the subjects will learn to discriminate between the picture and the real thing. If some responses to the picture are rewarded and others are extinguished, the person may be expected to learn to respond to the picture in certain ways as if it were the real thing and in other ways as if it were different.

Furthermore, it seems to be possible for individuals to learn to pay attention to certain classes of cues and to ignore others. Thus, by learning to pay attention to the cues that are similar in pictures and reality and to ignore those that are different, a person can build up a relatively general ability to react appropriately to a certain type of picture. It is said that on first exposure to a photograph of a friend, the natives of Africa show much less recognition than do those from other continents. Perhaps this is because the Africans have no experience with art which represents things on a surface, but only with art which consists of three-dimensional models. Similarly, natives who have not learned how to respond appropriately to

[8] Gibson (1954) presents an excellent discussion of these factors which must be considered in evaluating the fidelity of a picture. As he points out, we need more research on the effects of these factors.

motion pictures are reported to react hilariously to dollying from a far shot to a closeup. They apparently do not respond as if they were coming closer to the man, but as if he were growing tremendously.

As one goes from picture to diagram, the amount of similarity, and hence stimulus-generalization, is reduced so that there is more need to learn the conventional units of representation. To the extent that a diagram emphasizes those cues that are similar in a class of otherwise different objects, learning to respond appropriately to the diagram may be expected to favor generalization to the different members of the class.

Finally, with strictly arbitrary conventions, such as with most verbal responses, stimulus-generalization from the original object is no help; completely new learning is required. An appropriate response to such an arbitrary convention, however, may be helped by stimulus-generalization from other similar arbitrary conventions.

It is obvious that the foregoing type of analysis can and should be tested by using pictorial and diagrammatic materials as stimuli in experiments on stimulus-generalization, discrimination, and learning to respond to certain aspects of a complex pattern while ignoring others.

Realism—Learning from Pictures

The same type of considerations we have just discussed apply when the generalization is in the opposite direction—from the picture to the real-life situation.

In educational theory, the principle of stimulus-generalization is often referred to as *transfer of training*. A corollary of this principle is that it is desirable to teach students in situations that are as similar as possible to the ones in which they will be expected to use their habits. The greater the similarity, the less is lost by stimulus-generalization.

From this point of view it would be desirable to make training films as realistic as possible. One of the advantages of such films should be that it is frequently possible to achieve greater realism

through them than by any other means. For example, as would be expected because of the lesser amount of stimulus-generalization required, Roshal (1949) and Jaspen (1950) have found that films using the subjective camera angle, which presents the demonstration from the same angle that the student will view it when he is performing the task, were superior to those using the angle of view that the student has when he is watching an ordinary demonstration.

Physical Conditions of Viewing—Fidelity of Picture

With highly motivated students who are experienced viewers of pictures, one might expect such factors as size of screen, distance from screen, angle of view, and illumination to be critical only if they interfere seriously with the presentation of the relevant cues. Thus a series of studies summarized by Gibson (1947) found that as long as the problem situations presented on film were clear and the particular cues used were well above threshold, the conditions of viewing were not important. In these studies, however, depth, shape, and other cues which are optically distorted by departures from the theoretically correct viewing point were not crucial. We need additional studies of the effects of various distortions on phenomenal constancy and on learning from pictures. We also need detailed studies of the principles involved in the human organism's remarkable ability to learn to compensate for various types of distortions.

Similarly, we know in a general sort of a way that there is an enormous amount of redundancy in the information usually brought to us by our eyes; in many cases, we can still perform reasonably adequately when the number of cues is tremendously reduced, as in driving at night. We need further research to tell us how much fidelity pictures need for different uses.

Focusing Attention on Relevant Cues

In many learning situations, there are a large number of irrelevant cues. The actual object may be complex and baffling.

One of the problems of efficient teaching is to build up a discrimination so that the student will respond only to the relevant cues and not be misled or distracted by the irrelevant ones. Gagne and Foster (1949) found that giving preliminary training with a little booklet containing pictorial representations of a task improved subsequent learning. They believe that one of the main functions of this preliminary training was to help the students to learn to differentiate the relevant cues. We would expect motion pictures to be able to improve learning by focusing attention on the relevant cues. As we have seen, Lumsdaine and Sulzer's (1951) study showed that pop-in labels, which help to focus attention, can improve learning.

We would expect other techniques, such as deliberate exaggeration or diagrammatic simplification, to emphasize the relevant cues. Thus evidence reported by Gibson (1947) suggests that in teaching military personnel to identify friendly and enemy aircraft, a distortion which exaggerates some feature in which a given airplane is different from all others will lead to improved identification of it in subsequent tests without the distortion. Color should be an advantage if it is one of the most relevant cues or can be used to emphasize the relevant cues; it should be a disadvantage if it distracts or complicates.

Similarly, special attention-gaining devices should help if they direct attention to the relevant cues and hinder if they fail to do this. These expectations are in line with the general opinion of experts that artiness and slick production techniques are of no use unless they contribute directly to the clarity of the presentation.

Abstraction

Often the actual object or piece of equipment may be too specific. We are interested in teaching a response which will generalize to a whole class of objects or situations. This generalization can be facilitated by using techniques, such as caricature and diagrammatic simplification, to emphasize the cues that are common to all of the members of the class, and to minimize or omit the cues that

differ. It requires thoughtful analysis to select the appropriate cues for a pictorial abstraction—for example, how would you make a drawing which best represented the ways in which various dogs are similar to each other and different from other animals? The process of abstraction can also be helped by exposing the student to a variety of specific examples of the class and focusing his attention on the common elements.

Realism Versus the Relevant Cue

It can be seen that the various means of directing attention toward the relevant cues or of abstraction will almost inevitably involve departures from strict realism and come into conflict with the principle of stimulus-generalization. The relative importance of these two contradictory principles will depend on the particular conditions of learning. For example, in one situation finding the relevant cue may be the most important factor, so that a cartoon which focuses attention on that cue will be superior to live photography, but in another type of situation realism may be the most important factor so that live photography will be superior. Thus, studies aimed simply at comparing the two techniques without taking account of the detailed requirements of the task, are likely to produce misleading and inconsistent results.

When the dilemma posed by these conflicting principles appears to be acute, one way out should be to use the various attention-focusing devices during the early stages of learning, and then after the student has learned to identify and respond to the relevant cues, gradually change the presentation in the direction of realism, eventually putting in all the distractions and variations that he is likely to encounter in the real-life situation. Similarly, when trying to build up a general concept, it might be desirable to fade from one concrete example to the abstract representation, and then to a different concrete example, continuing the process until the main dimensions of variability were covered. It can be seen that in many cases it will be easier to accomplish this by motion pictures than by any other technique.

The foregoing analysis is based on stimulus-response learning theory; its specific application to graphic communication should be experimentally tested. We believe that it is extremely important to learn more about the interacting dynamics of these two opposing factors: realism versus simplification, abstraction, and emphasis on the relevant cue.

Role of Job Analysis in the Selection of Cues

We have been talking about relevant and irrelevant cues. It is not always obvious, however, which are the relevant cues. Before we can decide what cues to emphasize in a pictorial representation, we must make a correct job analysis of the expert's performance and the learner's task. For example, before trying to teach student pilots how to land an airplane, we must answer the question: "What cues can be used most effectively in judging altitude, direction, and drift?"

Research on Teaching Discrimination— How To See Better

Why do some people looking at a room, an athletic contest, or a picture see so much, while others see almost nothing? How is the amount that can be reported immediately after looking at a picture influenced by different variables? How is the retention of visually presented material influenced by different variables? How are the relevant cues learned? We believe that research on such questions would be valuable.

One of the variables influencing what people see is training or experience. The experienced coach notices details about a complex football play which are not seen by the average spectator. The first time a student looks through a microscope, he is baffled; eventually he learns to identify the details of this strange new world. In many cases, an important part of the task of the novice is to learn to discriminate new cues. We need more research on the problem of acquired distinctiveness of cues. What are the most effective ways of teaching people to see better, either when looking at a picture or when looking at a real situation?

For example, Miller (1947) and his co-workers believe that the motor movements in the crucial skill of landing an airplane are simple enough so that the real difficulty lies in knowing when to make the proper movement. According to their analysis, the main difficulties of the novice are perceptual—e.g., he does not see that he is undershooting the field, drifting, leveling off too high, or starting to swerve. All of these errors are painfully obvious to the instructor; the student looks hard but remains oblivious. What is the most efficient way to teach the student pilot the discriminations involved in landing a plane? Can some of this training be done more economically by motion pictures than by actual flying?

In order to be able to give better answers to such questions, we need more research guided by hypotheses such as the following: (a) the best way to teach a discrimination is to begin with easy extreme cases and gradually work down to finer differences; (b) discrimination is facilitated by close contrast in time and space; (c) it is desirable to require the student to make some sort of differential overt response; (d) immediate knowledge of results helps; (e) the principles involved in learning visual discrimination also apply to other modalities and will be useful, for example, in training a musician, a perfume chemist, or in teaching students to discriminate nuances of social behavior. We also need to investigate possible similarities and differences between the situation in which the student needs to learn a new discrimination and that in which he needs to learn to pay attention to the relevant one out of a large number of cues which he already can discriminate.

It is reasonable to assume that the same laws govern perceptual learning (i.e., that which enables people to learn to identify stimulus objects) as govern the learning of motor responses to those stimulus objects. But this hypothesis is far from being proven; it needs experimental investigation. We should also investigate the possibility that perceptual learning is governed by different laws.[9]

[9] For a somewhat differently oriented discussion of perceptual learning, see Gibson and Gibson (1955); for a summary of the literature, see E. J. Gibson (1953).

Research on Representing Motion—Animation

We need basic research on different ways of representing motion and depicting events. One useful point of departure would be a psychophysical study of movement perception. While there are quite a few studies of the phi-phenomenon of apparent movement, there are almost no studies of real movement. For example, the same physical movement has a different apparent velocity when it is horizontal than when it is vertical, but nobody has exactly measured this constant error.

We also need more research on different ways of representing motions—e.g., by a trail of light, by a strip picture showing sequences of moving parts, by a succession of slides, or by a motion picture. For the motion picture, we should investigate such simple things as the number of frames that can be exposed in each position without losing instructional effectiveness. Human engineering research has shown, for example, that a dial marked off in a fine scale may be read *less* accurately under operational conditions than one marked off with a coarse scale which requires the subject to interpolate. Similarly, there is no certainty that putting more information into the motion picture will mean that the student will acquire more. In short, we need scientific studies to lay a rational foundation for rules of animation.

In making such studies, we must distinguish between the purposes for depicting movement: conveying a general idea of what has happened, or depicting a sequence of movements which the student must copy. Widely separated stills, as in the comic strip, may be enough to convey what has happened without enough details to allow the viewer to copy the act. Thus research on movements will shade over into research on the depiction of events.

Some Additional Research Problems

We also need a systematic program of research on form perception. The psychology of perception has proceeded for over a

century by analyzing the continuous variables, such as loudness, brightness, and the saturation of colors, for which convenient physical measures are available. One of the lacunae in visual perception is the failure to analyze form into its variables. We need to make a psychophysical analysis of visual form in the same way we have worked on other stimulus attributes.

We need more research on the relationship between the perception of depth in physical space and in pictures. For example, there is much redundancy in cues for depth. Thus, Gibson (1950) has shown that even without binocular vision, one can make very accurate estimations of distance and size from pictures. We do not have, however, quantitative studies to tell us exactly how much accuracy of depth perception is lost by eliminating different cues from different situations.

The effects of the size and the scope of pictures should be investigated. Can children in the third grade get a general impression of what a broad country scene looks like from a small cut in a textbook? A large picture may be quite important for some uses, but for others the wide screen of the cinemascope may interfere with concentrating attention on the significant action. It would be desirable to make a systematic study with various types of subjectmatter of the relationship between the size and scope of the picture and what the student learns from it.

A systematic study should also be made of the effects of different photographic techniques, such as lighting, on the pattern of eye movements of students looking at a picture. At the same time, we should determine the relationship between the pattern of eye movements and what the student learns from the picture.

chapter 14

Response: The Student Must Do Something

IN ORDER to learn, the student must respond—he must do something. At first glance, it might be thought that the response variable is absent from learning by motion pictures. But many important responses, such as thinking and emoting, are internal and hence not obvious. As we have already seen, physiological measures, such as the psychogalvanic reflex, show that the viewer does make emotional responses to a film. He also responds with images and thoughts. These perceptual and ideational responses are extremely important. For example, two people watch an Indian ceremonial dance. They both view the same scene, but one comes away with a profound sense of the meaning of pagan worship and the other with only something to laugh at. Similarly, the expert who is examining an antique responds differently from the novice and learns much more about its history and value. If a student makes only irrelevant responses to a film, we will not expect him to learn anything relevant.

Need for Research on Responses to Pictures

As a point of departure, we assume that ideational responses —thoughts and images—follow the same laws as overt responses. This hypothesis should be sharply distinguished from the older behavioristic one that all thoughts are incipient peripheral responses. We are not primarily interested in the anatomical locus of the response—whether in the vocal cords or in the brain—but rather in the laws which it follows.

There is considerable evidence suggesting that ideational responses do follow the same laws as overt ones. Psychotherapists have shown that thoughts are influenced by motivation and reinforcement in the same way that overt responses are, although being less effortful, they may require less reinforcement (Dollard and Miller, 1950). Even the visual images of dreams are no exception. For example, Holmberg (1950) showed that the members of a primitive tribe who were frequently exposed to extreme hunger dreamed primarily about food. Images and thoughts can compete with each other just as overt responses do—it is hard to think of two things simultaneously. Thus if students are daydreaming, they are less likely to be making relevant responses to the lecture or film. Just as overt responses can be chained together, one thought can lead to another and thoughts can lead to action. Experimental evidence (Grose, 1953) shows that there is almost complete generalization from the cue produced by the overt response of saying a word aloud to the cue produced by thinking the word.

The foregoing type of analysis can serve as a point of departure, but we need to know more about the perceptual, ideational, and emotional responses which people make to pictures, and more about how these responses lead to action. We need to develop nonverbal techniques for studying images and perceptions.

We should try to find out whether the reporting of responses to films can be improved by using trained observers—being careful, however, not to train them to reflect the experimenter's prejudice.

A careful description of the many ways a student can respond to a picture will be completely different from the usual stereotype of the student sitting passively in the dark. It will help to break down some of the interfering attitudes which transfer from the entertainment to the instructional film. More significantly, it will serve as a logical foundation for research aimed at improving the student's responses to films.

Basic Response Units Must Be Present

Transmission-communication analogies can be misleading. Pictures do not automatically transmit knowledge; they can only sup-

ply cues activating those habits that the individual already has. If the student does not have the prerequisite habit units, our films will not arouse motivation, communicate knowledge, or teach the skill.

The motion picture cannot create any completely new response units; it can only repattern and recombine those that the viewer already can make to the visual and auditory cues which it presents. The function of the instructional film is to use audio-visual cues to elicit new combinations and sequences of responses, and to attach responses to new patterns of cues. As we have already seen, the motion picture will be a superior way of doing this in those situations in which it is superior for reproducing and directing attention to the crucial cues. It will also be superior if it is able to marshal a wider variety of superior cues for eliciting the correct responses. An example of this latter advantage is the case in which the basic movements of a skill can be elicited easily by copying someone else's movement but cannot be elicited easily by purely verbal direction. A limitation is the case in which the movements are so novel (as in an elaborate ice-skating figure for someone who has never skated) that they cannot be elicited by demonstration but must be learned by laborious trial and error.

The size of the functional units is important. A skilled performer is likely to have a repertoire of many complex sequences, each of which can be elicited as a large, already organized unit. For him the learning task may be to recombine only a few of these larger units. By contrast, the novice may have to try to copy each separate detail, and thus have many more functional units to recombine. This will make his task of learning from a demonstration much more difficult so that he will need a much slower rate of development and more repetition.

If the producer clearly realizes the points we have been making, he will be less likely to expect the impossible; he will be more likely to use his maximum ingenuity to develop techniques for using those cue-response units that are in the repertoire of the target audience. Similarly, the teacher should recognize these limitations. He should make a list of the response units (e.g., skills) demanded

by the film. If any student does not have these response units, the deficiency should, if it is possible, be corrected before the film is presented.

Learning from Demonstrational Films as Delayed Imitation

Miller and Dollard (1941) have analyzed the important role of imitation in social learning. They have pointed out that the technique of demonstration is an efficient way to elicit the correct response and reduce wasteful trial and error. May (1946) has analyzed learning from demonstration films as a case of delayed imitation. Delayed imitation should be harder than immediate imitation—the difficulty becoming greater the longer the delay. May's analysis suggests the desirability of providing opportunities for practice as soon as possible after the demonstration. One way of accomplishing this is to insett pieces of black leader at strategic places so that it is easy to stop the film while the student practices. A better way will become available with the completion of the development of the magazine-loading motion picture projector described by Lumsdaine (1953, p. 83) which is designed to stop at any desired point and leave the still frame on the screen at full illumination. May's analysis also points to the need for studies of the effects of delay (i.e., the visual memory-span and retention curve) on different types of materials.

Delayed imitation is mediated, presumably, by imagery or self-instructions which are elicited immediately by the demonstration and reinstated later during the practice. Thus, Thompson (1944) has found that learning from a demonstration is hindered by conditions which would be expected to interfere with these mediating responses and helped by conditions favoring them. Her study suggests that it is desirable to label or number the parts or tools to be manipulated and to design the commentary to help the observer to formulate for himself an adequate set of verbal directions for performing the skill.

Participation and Mental Practice

As would be expected from the preceding analysis, learning can be improved by requiring the student to rehearse relevant responses during a film. Good experiments have been performed on this variable. We should note that these are not experiments comparing response versus no response; they are rather experiments on procedures designed to increase the relevance and amount of response by forcing the student to respond in a way that the experimenter can observe.

Hovland, Lumsdaine, and Sheffield (1949) reported an experiment using a sound filmstrip to teach students to memorize the military phonetic alphabet. They found that much better learning occurred if, instead of the conventional passive review of each section of the alphabet, the audience was required to recite aloud in unison each letter-word combination. Similarly, in the more complex conceptual task of learning information about the heart and the circulation of the blood, the Yale Motion Picture Research Project's staff (1947) found that learning was improved by inserting into the film questions designed to increase participation and motivation. These and other studies show that the participation procedure can be used to increase the effectiveness of films.

Analytical Studies

We know that participation can improve learning. We need additional, analytical research, however, to increase our basic understanding of the types of response which are necessary and the variables involved. Such research will help us to use participation most effectively in a wide variety of situations. For example, a study by Roshal (1949) suggests that introducing participation too early into a sequence that is paced too fast may even interfere with other responses which are necessary for learning. A study by Jaspen (1950) shows that a slower rate of development can increase the effectiveness of the participation procedure. The results of these studies would fit in with the view that practice only makes

perfect when the correct responses are practiced. If the film presentation has not been adequate to elicit correct responses, practice in the form of participation cannot help much and may even tend to fixate some wrong responses. As would be expected from this type of analysis, Kimble and Wulff (1953) found that increasing the amount of guidance given during participation exercises makes them more effective.

Michael and Maccoby (1953) found equal gains from overt and covert participation, an additional gain from knowledge of results, and persistence of the difference between participation and nonparticipation groups in spite of a warning to all groups that they would be tested after the film. They also found that the effect of participation questions tended to be specific to the material rehearsed as would be expected if the main function of these questions was to elicit specific responses rather than to raise the general level of motivation. These studies, and others described by Lumsdaine (1953, pp. 86-89), represent excellent progress toward a more detailed analysis of an important variable influencing the teaching effectiveness of graphic materials. This analysis should be continued; similar analyses should be made of other important variables.

In view of the effectiveness of instructions for covert verbal rehearsal, it would be interesting to study the effect of instructing the students to respond with visual or kinesthetic imagery. We should also try to introduce practice of this kind into the structure of a film by the anticipation method—i.e., to require students to try to anticipate the correct response by visual and kinesthetic imagery and then to correct their errors after seeing a picture of the correct performance.

Need for New Equipment and New Types of Film

The fact that certain kinds of overt responses are difficult to make under the ordinary conditions of motion picture viewing presents a special challenge to producers and users of instructional

film. But the ordinary conditions of film viewing, which are carried over from the entertainment film in the theater, do not need to be transposed bodily to the instructional film. Various radical innovations should be tried. For example, if one has the proper equipment, one can project a model performance for the student to copy in the shop, on the assembly line, or in the field. For doing this, the "daylight" screen, magazine-loading projector, and the loop-film technique should be very useful. With such a technique, the student can be allowed to project the film, watch it and practice until he has perfected one step, and then move on to the next step.

Type and Timing of Response

In approaching the problem of response we should ask the following questions: What are the cues present at the time the response is made? What kinds of response facilitate learning and what kinds interfere? How much response is needed? What is the proper timing of the response? For example, for a given response, which is the most effective: practice while the picture is being shown, practice immediately after the picture, or delayed practice? It seems reasonable that one should not ask the student to start practicing until he has enough background and orientation so that he will be likely to practice the correct rather than the incorrect responses. We would expect this stage to be reached at different times, depending on the difficulty of the material. Although a study by the Commonwealth Office of Education (1950) concluded that it was best to hold a discussion immediately after the first showing, reinforcing the learning and retarding the rate of forgetting, in dealing with more complex material it might be better to start the practice after the second showing, when the students are more orientated and better able to perform correct responses.

Motivation Favors Relevant Responses

Students who are motivated to learn will be more likely to respond to films by rehearsing and thinking, and less likely to make

irrelevant responses such as daydreaming or going to sleep. One of the important effects of motivation is to favor the occurrence of correct responses. This effect probably accounts for much of the improvement in learning produced by various techniques for increasing motivation, such as warning that an examination will be given. Suitable introductory material should be able to favor correct responses by increasing motivation and also by getting the students set to make specific types of responses.

Rate of Development

The responses which are necessary for learning take time, particularly for the student who begins at a low initial level of experience. This fact is not kept vividly enough in mind by producers of training films; one of the most common errors is to try to pack too much material into too short a film. Makers of training films must resist the desire to save on the cost of film and the maladaptive tendency to generalize from entertainment where fast action is often desirable.

Rate of development is not, of course, a simple, unitary variable; rather it is a term that comprehends a number of more specific factors such as rate of speaking, amount of pausing for emphasis or observation, amount of oral or visual redundancy, and repetition within a film. "Rate of development" treated as an undefined composite has been shown by Jaspen (1950) to be related to the amount of learning from films demonstrating a mechanical assembly. Similarly, Kopstein, Sulzer, and Lumsdaine (1952) have demonstrated that intra-film repetition by use of added examples increased learning in films on micrometer reading. These investigators showed that the "point of diminishing returns" for adding of further instructional examples depended on difficulty of the material and intelligence of the learner, but that in any case there was value in giving more examples than often is done in the "once over lightly" type of training-film treatment.

Summaries and Reviews

Assuming that other conditions of learning, such as motivation and reward, are present, repetition should improve learning by increasing the probability that the correct response will occur at least once and by providing an opportunity for it to be practiced repeatedly. There is considerable evidence, summarized by Hoban and van Ormer (1950), that reviews and summaries within a film and repeated showing of the same film can improve learning. In those cases in which the response needs to be attached to more than one relevant cue, repetition with the appropriate variety of stimulus conditions should be particularly desirable.

chapter 15

Reward: The Student Must Get Something He Wants

FOR EFFICIENT learning, the student must be rewarded, in other words, get something he wants.

Since the student must want what he gets in order for it to function as a reward, drives and rewards are closely related. Furthermore, the promise of a reward, especially if it is backed up by actually receiving the reward, can help to raise motivation. When the motivation is fear or punishment, the escape from the fear or punishment serves as the reward.

Delay Reduces Effectiveness

Immediate rewards are more effective than delayed ones. When the reward is delayed, it is necessary to have some stimulus trace, symbolic response, or token-reward to bridge the gap by being immediately associated with both the correct response and the eventual reward.

Films Depend on Learned Rewards Reinforced in Real Life

Since the banning of the hickory stick, teachers have largely been limited to using learned drives and learned rewards. Because the primary rewards are received in real life, the films must operate with the learned rewards that the students already have acquired. Many of these learned rewards vary markedly from culture to

culture; even within a culture they vary with factors such as age, social class, sex, regional and ethnic origin, and occupation. If the habits learned via the film are not rewarded in the life of the student, he will extinguish those habits and be harder to teach the next time; if they are rewarded, his motivation to learn from films will be strengthened.

Knowledge of Results

For the student who is motivated to solve problems or learn, finding out that he has done well is an important reward. Knowledge of results can serve as a reward to strengthen correct responses; it can function also as a punishment to eliminate incorrect responses, and as guidance in correcting errors. Studies by Michael and Maccoby (1953) and Gibson (1947) demonstrate the efficiency of combining practice during the showing of visual materials with knowledge of results. One study reported by Gibson showed that practice reinforced by knowledge of results was 40 percent superior to practice without knowledge of results.

Like other forms of reward, knowledge of results is more effective when immediate than when delayed. Studies summarized by Hoban and van Ormer (1950) show the advantage of giving a test soon after the showing of a film with quick knowledge of the test results. Hirsch (1952), who also finds that knowledge of results facilitates learning, reports that more meaningful knowledge of test results produces more effective learning.

Reward for Matching a Model—Copying

We have already seen that one of the uses of instructional films is to present a model of behavior for the student to imitate or, in other words, copy. Let us now consider some of the details of the process of copying. A more thorough discussion is given by Miller and Dollard (1941).

The completely inexperienced student must begin by learning to discriminate whether his behavior is acceptably similar to that

of the model or unacceptably different. Thus in learning to copy a melody, the completely naive student must first learn to discriminate whether the note he hears himself singing is the same pitch as the one he hears the teacher singing. Similarly, in learning to speak a foreign language, the student must first learn to hear certain new differences in pronunciation. The student learns these discriminations by reward for correct behavior and non-reward or punishment for incorrect behavior. In conventional instruction, the same teacher who serves as a model also serves as a *critic* to reward behavior that is acceptably similar, to punish behavior that is unacceptably different, and to specify the direction and size of the corrections that should be made. In short, the critic supplies knowledge of results.

Eventually, the student learns to label an acceptable match with the model as good and an unacceptable one as bad. These labels serve as self-administered rewards and punishments for the student who is trying to copy. He may also learn to respond directly to the cues of difference from the model with a certain amount of motivating tension and to the cues of similarity with immediate rewarding relief. At the same time, he is also learning to respond to the direction and size of his errors with appropriate corrections—e.g., raising his pitch when he hears himself singing flat, or moving to the left when he sees that he is too far to the right. After the student has learned the appropriate motivational, correctional, and rewarding responses to the cues of difference and sameness, he can serve as his own critic during further practice in copying the model.

In many instances, the relevant discriminations of sameness and difference have been learned so early and generalize so widely to new contexts that we take such discriminations for granted. In other instances, such as learning a phoneme that is not in the English language, the student may not know that he has made an error or what correction to make. It is obvious that the research we have already recommended on the process of learning to discriminate—especially learning to discriminate sameness and difference—should help us to deal more effectively with this latter type of case.

The conventional demonstrational film serves as a model but not as a critic. We may expect well-motivated students to learn by copying it if, and only if, they have already learned the units of discriminating the relevant dimensions of sameness and difference so that they can serve adequately as their own critics. If these units of discrimination are inadequate, some provision will have to be made for supplying the critic function. Often it may be found that the needed discriminations are not completely absent, but only are not exact enough. In such cases, various techniques of clarification, exaggeration, and direction of attention to the relevant cues of sameness and difference may change failure to success.

The social conditions of learning frequently punish behavior that is obviously different from that of the rest of the group and reward behavior that is the same. Thus certain cues of conspicuous difference—being the only person in formal dress at a dinner—may elicit uncomfortable anxiety, and certain cues of sameness—finding that one's opinion is similar to that of a person of great prestige—may be rewarding. Sometimes these responses to sameness and difference are mediated by verbal cues; in other instances they may be elicited directly without any intervening thoughts. In the latter case, these cues of difference and sameness may motivate and reward unconscious copying. We believe that this process of unconscious copying plays an important role in the use of pictures to influence people. It is probably involved in identification with the protagonist, a factor we have already discussed. Additional research on the psychological dynamics of copying and the social conditions rewarding it should yield valuable results.

Problems for Research and Development

Relatively little research on instructional films has been specifically directed at manipulating the reward variable. Since the sequence in the film is traditionally independent of the responses that the student makes, ingenuity is required to make rewards specific to correct responses. Solving the problem of immediate

reward, however, will greatly increase the teaching effectiveness of graphic media. In some cases, it should be possible to create films using the anticipation method with immediate knowledge of results. In other cases, it should be possible to develop new equipment. For example, one of the chief advantages of the recitation machines described by Skinner (1954) is that they supply immediate knowledge of results; for certain purposes graphic techniques could be used in such a machine. In other instances, it might be possible to use a system of push-button answer choices—analogous to the Classroom Communicator (Eggleton, *et al*, 1950)—keyed to signals from the sound track of the film to notify each student immediately by a light and counter on his desk whether he has increased his total score by a correct choice or decreased it by an error.[10] Attempts should be made to discover yet other solutions to the problem of immediately rewarding correct responses to audio and visual materials.

Finally, we believe that the following questions would serve as points of departure for fruitful research:

1. In the entertainment field, the happy ending technique with virtue rewarded and wrong punished seems to get the audience to come back next week. Does the student viewing an educational film get vicarious punishment and reward from seeing the protagonist reap bad consequences from incorrect responses and good consequences from correct responses?

2. Does producing closure by a happy ending sometimes stop the students from further thought?

3. Is learning helped by the technique of building up suspense and then telling the students in the last minute the solution we expect them to remember?

4. Is it efficient to have the students fail on the first trial in order to make success on later trials a stronger reward? One

[10] A device could be made to be plugged into the sound system of a standard projector. A circuit tuned to a specific frequency would pick up a strong signal of that frequency. The first blip would turn off the regular speaker system for an interval; the succeeding blips would operate a stepping relay (or silent electronic counter) determining which answer would be scored as correct. For other types of material, a filmstrip projector might be used with the position of a notch in the side of the film determining the answer to be scored as correct.

formula for training is to cause the students to fail, tell them why, and then let them succeed.

5. Can the general pleasantness of the situation—e.g., the aesthetics of the film—have a reward effect facilitating learning?

6. Is one of the rewards for looking at a television program to talk about it afterwards? Similarly, in visual education, should we not pay more attention to the responses the person practices afterwards in his social group and how the group reacts to these responses—with reward or punishment?

chapter 16

Problems Involving a Number of Factors

Specificity Versus Generality

THE CONSENSUS of experts is that the influence of the motion picture is more specific than general. The specificity of learning from pictures has sometimes been used as a criticism of them. But films do not seem to be unique in this respect. Students learn what they are taught and do not learn what they are not taught. There seems to be no such thing as improving the general faculty of memory; one can only learn certain techniques of memorizing material. This fact means it is important to make a detailed job analysis of exactly what the student needs to know. The demands of the real-life situation must be analyzed and the differences between better and poorer ways of meeting them must be identified.

Often what seems to be generality comes from learning a number of habits by practicing the same response in a large number of different related situations, practicing different ways of achieving the same goal in the same situation, or a combination of these two techniques. When this is the case, a number of different films, or a number of different treatments in the same film will be required to produce a general effect.

On the other hand, it is extremely important to note that different habits, each in itself equally specific, may have different degrees of generality of application. For example, one person might learn to distinguish a particular manufacturer's product for a given year by the color of the box. If these cues change from year to year, his learning would be highly specific, but if another

person learned to distinguish the same product by looking at one corner of the box for the trademark which remained the same from year to year, his learning would be more general. The trademark habit would be specific to the trademark and the color-of-the-box habit would be specific to color, but the trademark habit would be useful over a longer period of years than the color one—it would apply with greater generality. As we have already pointed out in the discussion of "Abstraction," various devices (such as caricature, pop-in labels, and diagrammatic simplification) can be used to help the students to respond to the most generally relevant cues. Pictorial techniques can be an effective way of teaching certain general concepts.

Superiority of Logical over Rote Learning

Similarly, logical learning utilizing basic principles has a greater degree of useful generality than rote learning. During the long and painful history of cultural development, those rules which people have tested and found to have a wide degree of usefulness are called basic principles. They embody a long history of attempts to find the most widely applicable solutions to problems. This is one of the reasons why it is highly advantageous to use these basic principles.

Another reason for the generality of logical learning is that each step is guided by an anticipatory goal response instead of being elicited merely by the preceding step. The process is similar to reasoning as analyzed by Dollard and Miller (1950). Therefore, we would expect logical learning to provide a better basis for creative thinking in new situations.

Wertheimer (1950) has shown that, when students are taught by a rote method to prove the theorem of the area of a parallelogram, their learning tends to be specific to the particular orientation of the parallelogram. When they are taught by a logical method in which each step is definitely related to the goal, their learning generalizes to other positions and other figures. It would be astonishing if a similar difference were not found when these two

methods were used in two training films. In fact, a superior use of the logical method in a training film should produce a more general result than a lecture using the inferior rote method which is all too common in the classroom. The latter comparison would not be one between two media but rather between a superior and an inferior method. The film would be used as a means of presenting the superior method.

Scientific proof of the difference which we expect would have two important effects: (a) it would counteract the widespread impression that motion pictures necessarily produce an inferior type of learning by failing to stimulate the acquisition of general, abstract concepts, and (b) it would call attention of the producers of training films to the fact that a correct theoretical analysis can enable them to make films that will teach students habits of wider general applicability—a goal of the greatest importance.

In addition to teaching the student general principles, it is necessary to give him practice in applying them to the different actual situations in which we want them to be used. In many cases, the realism of the motion picture may conveniently be used to bridge the gap between principle and application.

All of the hypotheses advanced in the foregoing discussion should be tested, refined, and extended by experimental studies using graphic and other media. We cannot overemphasize the importance of research on the problem of increasing our understanding of the kinds of learning that have the widest application, or in other words, the greatest generality.

Meaningfulness and Organization of Material

Many experiments on traditional verbal learning show that meaningful material is much easier to learn than non-meaningful material. Similarly, organized material is better learned than disorganized material. The effect of these variables is not completely understood, but they are probably related, on the one hand, to better use of habits that the student already has in his repertoire,

and on the other, to the greater generality of logical learning which has just been discussed. In any event, these variables should also be extremely important in learning from instructional films. We should apply to educational films what we know from experience about the advantages of meaningfulness and organization of materials; we also need to increase our scientific understanding of the effects of these highly significant variables.

Forgetting and Review

With the passage of time, forgetting usually neutralizes some of the effects of learning. There is considerable evidence that forgetting is not a simple automatic effect of the passage of time, but is produced by learning new incompatible habits either to the same cues or to other cues that are similar enough so that the interfering habits generalize. Following this line of analysis, one might speculate that the greater detail of the patterns presented in pictures would decrease the likelihood that a functionally identical stimulus would be encountered in some other situation in which an interfering habit was learned. This would explain why in Lumsdaine's (1949) study, memory was superior when the picture instead of a word was used in the cue position. We need additional research to determine forgetting curves for visual memory and to analyze the factors affecting these curves.

It seems probable that, when responses are learned to a greater variety of cues, they are less likely to be forgotten. And, the addition of the motion picture techniques to other media of instruction seems likely to increase the variety of cues. On the basis of a number of studies summarized, Hoban and van Ormer (1950) suggest that learning from motion pictures often is especially well retained.

Finally, the fact that forgetting seems to occur rapidly at first and then more slowly, affords a rationale for the practice of using a fairly prompt review followed by additional reviews at progressively increasing intervals. This practice has been found highly desirable with other media of instruction; it should be beneficial when used with instructional films.

Value of Demonstrating Errors

In addition to showing the correct response, it should be useful to demonstrate errors, labeled as such, in training films. It seems probable that this will help the student to identify the errors and to be specifically motivated to correct them. It may also help the student to avoid certain wrong responses, and help him to discriminate the correct cues and responses by contrasting them with the incorrect cues and responses. Finally, demonstrating errors may decrease the amount of stimulus-generalization required, by making the film-learning more like the real-life situation in which errors must be made and corrected.

Dramatic Versus Expository Presentation

Although there have been relatively few studies (Hovland, Lumsdaine, and Sheffield, 1949) on the value of the dramatic form of exposition, theoretically one might expect the dramatic effects to arouse motivation, but one runs the danger of eliciting irrelevant motivation and introducing irrelevant cues and responses. The simple comparison of dramatic versus expository presentation does not seem likely to lead to fruitful research; careful analytical studies are needed.

Type of Audience

It has already been pointed out that one would expect the learned drives, the perception of cues, the responses elicited by cues, and the effect of learned rewards to vary with different types of audiences—especially with factors such as age, sex, education, intelligence, occupation, social class, geographical regions, ethnic origin, and any other major cultural differences.

Study Habits for Films

We believe that students must be trained to learn from films. The well-established entertainment set must be changed by devel-

oping the new habit of studying the film. We will expect suitably motivated and rewarded experience with training films to affect each of the fundamental factors involved in learning: increase drive to learn, improve perception of cues, strengthen the tendency to rehearse responses, and increase the rewarding effects of signs of improvement. Such an effect is suggested by studies such as VanderMeer's (1951) experiment on using a series of films to teach an entire course. As the proper use of educational films expands, the benefits should snowball.

Additional Comments on Research

Applicability to Children of Research on Adults

Relatively adult students have been used for most of the research on learning from pictorial materials. The most important of these results should be checked on children of different ages. For example, one might advance the hypothesis that the importance of actually performing overt responses during pictures decreases as people overlearn these responses and attach them to symbolic cues. If so, overt rehearsal would be least important for experienced adults, more important for inexperienced adults, and still more important for inexperienced children. In addition to the scientific importance of determining the generality of the principles, such experiments would have the practical significance of helping to convince people who are making films for children. Such people may well be skeptical of the relevance of principles discovered by military research to the task of teaching children.

The Free Versus the Captive Audience

The experience of people who make pictures for entertainment is with an audience which is free to attend or to stay at home. Similarly, much of the research on advertising deals with a free

audience. On the other hand, almost all of the research on the educational uses of pictorial materials has been performed with captive audiences who were not free to leave the classroom. With the expansion of educational television, however, it will become increasingly important to know how to teach members of a free audience.

It is generally assumed that the psychology of the free audience is quite different from the psychology of students in a classroom. This may or may not be so; or the two audiences may be similar in certain respects and not in others. For example, with a highly motivated captive audience it has been found that humorous sound effects in cartoons decrease the effectiveness of a film.[11] With a free audience, or with small children, it might be found that the humorous devices at least serve the purpose of keeping the audience awake or present. On the other hand, many of the principles of clear exposition should be the same for both captive and free audiences. It seems likely that the differences between captive and free audiences will hinge on differences in levels and types of motivation. We should bring together from various sources, such as advertising, information bearing on this topic. We should try to clarify the issues and design experiments to test possible differences between free and captive audiences.

Interchange of Ideas

The interchange of ideas among people working on graphic communication should be speeded up. The professional journal, *Audio-Visual Communication Review,* is helping; a news-note section on projects in progress could be added. Arrangements should be made to supplement this paper communication with a more personal one, by getting relevant people together for periodic conferences and discussion. Research in other fields, such as advertising, should be surveyed for findings relevant to graphic communication.

[11] Unpublished study by Lumsdaine and Gladstone, reported in Hoban and van Ormer (1950, p. 8-21).

Research on the Principles of Film Editing

One hypothesis is that a film depicting a skill should be edited to be as similar as possible to the visual experience produced by the eye movements of the expert performer. Another hypothesis is that a film should be edited to start with the eye movements of the beginner, and then to approach the patterns of the expert by the steps followed by a good learner. In either case, recordings of eye movements would be part of the job analysis guiding the editing of the film. Irrespective of the validity of these hypotheses, the question remains: Can we develop any scientific principles to guide the editing of films?

Evaluating Films

Measures of Savings Versus Recall

Most of our training research, including research on learning from films, has used the recall method to measure the retention of the material. Tests given after an interval of time may show practically zero recall, but this does not mean that there is zero retention. When the savings method is used, it is usually found that the students will relearn the material much more rapidly the second time. For example, by the time that soldiers get to the battlefront, one may find that they are completely unable to assemble a machine gun. This gives them a zero recall score but it does not necessarily mean that the training was wasted. Instead of taking several days to teach the men, one may find that a half-hour refresher course gets them back to the point of satisfactory performance. Wherever the student will have a chance to refresh his memory under the conditions of actual use, the savings method should be used to evaluate the effects of the training.

Testing Validity and Improving Efficiency of Evaluation

The ultimate test of the effectiveness of an educational film is some measure of how much the students learn from it. However,

such an evaluation is relatively costly. The most efficient way of evaluating films should be empirically determined.

At present most films are evaluated simply by having "experts" look at them. The fate of large investments depends on the decisions of the experts. But we have no check on the validity of their evaluations. It is possible that the experts are making the wrong decisions and wasting much money. The judgment of experts should be validated against factual data on the actual teaching value of the film or film episode.

It is possible, however, that once an evaluator is trained, his judgment will be found to correlate highly with a representative sample of factual studies. In this case, it would be much cheaper and faster to use the expert, spot-checking him occasionally against factual data, than to continue to evaluate each film by a separate research study.

One way of having a judge evaluate a film is to give him the test questions, with data on the number of correct answers students give on each item before they see the film, and ask him to predict the number of correct answers the students will give after the film. Another method is to show two versions of each episode in a film and ask the judge to predict which will produce better learning.

Twyford (1951) had students report by pressing buttons: (a) whether or not they liked each episode in the film, and (b) whether or not they thought they were learning from it. The report on liking did not predict improvement, as measured by a subsequent test, but the report on learning did. We need more studies like this which try to determine what is going on minute by minute while the audience views the film, and then try to find out how well these immediate responses by the audience predict the achievement of the ultimate goals of the films.

Money for Creative Men and Their Students Versus Project Proposals

The very fact that scientific research is an exploration into the unknown means that it cannot be guided by exact road maps.

The problems to be investigated and the variables to be measured are not already given, but must be discovered.

One of the ways that significant problems and relevant variables are discovered is by preliminary natural-history observation accompanied by speculative attempts to make sense out of what is observed. The history of science demonstrates that knowledge of immense practical importance can emerge from the attempt to make sense out of apparently trivial observations. For example, the study of the mutual attraction and repulsion of tiny pith balls suspended on silk threads led to the discovery of positive and negative electricity—a new form of energy which has transformed almost every facet of our lives, as we realize whenever the battery goes dead in our car or the power is cut off from our homes. Hitherto unsuspected new avenues of knowledge—X-rays, radioactivity, penicillin—have been discovered by following up accidental observations.

It is also useful to get successful practitioners to set down typical rules of guidance which emerge from their experience. Out of these one can evolve testable hypotheses, some of which eventually become verified principles.

Some of the most significant aspects of pushing forward into the unknown cannot be described in advance as neat project proposals which a committee can easily evaluate. Therefore, it would be highly desirable for grants of relatively unrestricted money to be given to men who are known to be creative in order to help them follow up unexpected, accidental discoveries, explore new areas, and advance problems to the stage at which specific projects can be formulated.[12] We believe that research on graphic communication needs its quota of preliminary observation and speculation and would greatly benefit from the award of grants of unrestricted funds to creative men.

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[12] The Behavioral Sciences Division of the Ford Foundation has taken an imaginative step in this direction with its Grants-in-Aid. This program should be expanded; it should be emulated by other farsighted organizations.

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AUDIO VISUAL

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